STAN VEIT'S HISTORY OF THE PERSONAL COMPUTER

From Altair to IBM, A History of the PC Revolution

Stan Veit

Editor-in-Chief Emeritus

Computer Shopper

STAN VEIT'S HISTORY OF THE PERSONAL COMPUTER

by Stan Veit

Editor-in-Chief, Emeritus

Computer Shopper

Published by:

WorldComm®

a division of Creativity, Inc.

Asheville, North Carolina

Publishers: Ralph Roberts, Jack Nimersheim, Stan Veit

Executive Editor: Kathryn L. Hall

Editor: Melody A. Grandy

Indexing: The Roberts Group, Greensboro NC

Cover Design: WorldComm®

Cover Photo: Courtesy Apple Computer

Interior Design and Electronic Page Assembly: WorldComm®

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

ISBN 1-56664-023-7

Library of Congress Number: 93-060161

Some of this material has previously appeared in abbreviated form in *Computer Shopper*.

WorldComm Press—a Division of Creativity, Inc., 65 Macedonia Road, Alexander, North Carolina 28701, (704) 252-9515—is a full service publisher.

Contents

Foreword

by Ralph Roberts

This is the book that I always intended to write. In fact, only one thing has stopped me–I'm not Stan Veit.

Stan and I were both associated with personal computers from their very beginning. We both saw the potential in these magical little boxes. We both had an inkling of the immense changes that personal computers would visit upon society and the world.

I began writing about computers in 1978, and accumulated box upon box full of magazines and photographs. I always wanted, you see, to do a book on the history of the personal computer, a history that was and still is literally being created before my awed and delighted eyes.

After more than 30 books and thousands of articles, most of them about computers, it's not the ability I lack. I could have done this book except... darn it... I'm not Stan Veit.

You see, while I watched the PC revolution from afar– though reading and writing about it–Stan Veit was right there on the front lines. He was living, breathing, eating, and sleeping with computers. He was influencing the course of the developing information-processing tide that was so soon to wash into all our lives. He knew the people who made personal computers first live, then triumph–the heroes and heroines, the rogues and the rascals.

While I worshipped these heroes of the revolution from my isolated vantage point, Stan saw not only their feet of clay but, at least in the case of Apple's legendary Steve Jobs, their *seats of fray*–as Stan tells it. If Stan's mother-in-law had not

repaired the seat of Jobs' tattered jeans, it is quite possible that Jobs and his partner, the Woz (Steve Wozinak), would not be multimillionaires today, nor would Apple computers be enjoying their equally legendary status.

That is only one minor example of Stan Veit's overwhelming authority to write *this* book. Stan knew the movers and shakers in the fledgling personal computer industry—indeed, he was and still is indisputably one himself. He also knew the kooks and losers, and those who had good ideas but couldn't make those ideas reality. He saw the good, the bad, and the machines that turned out to be little more than so much bull fertilizer.

Personal computers have changed the world, impacted on all of our lifestyles, both fulfilled and reneged on promises, and generally made our existences if not better, then certainly *different*.

If you use a computer, Stan's book tells you where it came from, and reveals to you the fascinating story of the personalities and machines that resulted in that sometimes friendly, sometimes disk-eating little cybernetic monster crouching on your desktop.

If you don't use a computer, the way things are going, you probably soon *will be*. This book helps you become computer literate by understanding the design philosophy of the major types of computers that won out in the long run—the IBM PC-compatibles and Apple's Macintosh. If you are familiar with this history, the computer jargon you'll encounter is a good deal more meaningful.

Above all—whether you are computer novice or a virtuoso at the keyboard—you'll find that Stan Veit spins a series of fascinating yarns about the history of the personal computer.

Yes, I should have done this book but... thank God... Stan Veit was available.

In all, to end on a serious note, what we have here is a significant contribution to the literature of computers, an important historical record by a man who lived that history. Stan Veit's history is that of personal computers. And it's both an enjoyable and truly remarkable one.

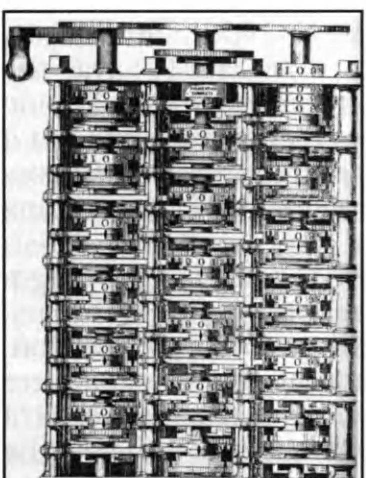
Introduction

As far as we know, the story of computers goes back into the 17th century:

Back to Blaise Pascal, who constructed the first automatic calculating machine, and Gottfried Wilhelm Leibniz, who thought of the binary system of notation.

To the start of the 19th century, when Joseph Marie Jacquard invented a loom that would weave intricate patterns in cloth and was controlled by punched cards.

To the great Charles Babbage who devised the Difference Engine and the Analytical Engine, whose parts were functionally similar to a modern computer.



Babbage's Difference Engine

To Ada, Lady Lovelace, who was the first programmer, and to George Boole, who devised a system called Boolean Algebra which solved problems logically.

Then, at the end of the century, the great Doctor Herman Hollerith built the tabulating machine which used punched cards to count the United States census, and founded the Computing and Tabulating Company which eventually became IBM.

The digital computer gradually took shape in the twentieth

century from the minds and hands of such great scientists as Alan Turing, Vannevar Bush, Howard Aiken, John Von Neumann, and Grace Hopper and countless others. Throughout the development period of the computer, there were people who dreamed of having a computer for their very own. A machine that would solve problems of their devising—a personal computer. The physical size, complexity, and scarcity of computing devices made this impossible. The machines, constructed with relays or vacuum tubes, were huge and complex, and usually there was only one of each type. In fact, Thomas J. Watson, the man who converted the old Computing and Tabulating Company into the International Business Machine Company, was at first opposed to going into the business of building digital computers because he estimated that the total demand for them would not exceed twenty five machines. It was not until the invention of the transistor at Bell Labs that the computer grew in power and shrunk in size, a process that has never ceased to this day.

The dream of the personal computer evolved during the late 1950's and 1960's. There were those who obtained obsolete models of the first minicomputers and managed to use them for personal projects, and there were even a very few who built their own computers in their homes.

James F. Sutherland, an engineer working for Westinghouse, designed and constructed a full working computer in the basement of his home in 1966. Sutherland's Electronic Computer Home Operator (ECHO IV) was the subject of much publicity because it was the first real home computer. This was no little box of electronic parts but a functional system built into four standing cabinets and controlled by two consoles, one in the basement for the programmer and one in the kitchen.

Stephen Gray, the Computer Editor on *Electronics Magazine,* had tried to build his own computer for several years. Failing, he realized how difficult this was for one person. Then he learned about Sutherland and others who were building or using computers and decided that some means of communication was needed to inform them about what the others were doing, to exchange ideas, and to get answers to problems. To do this, he established the Amateur Computer

Society by writing to seven electronics and computer trade publications, and to three hobby publications. He invited those interested to join a nonprofit Amateur Computer Society and agreed to publish a bi-monthly newsletter. About 110 people joined. The Society paid $3.00 to cover the cost of mailing the newsletter. Many people date the start of personal computing to the start of The Amateur Computer Society in 1966. During the next five years, minicomputers became smaller, and cheaper. Machines like Digital Equipment's PDP-8 became common in labs and classrooms throughout the country, and some even fell into private hands.

Then, in 1969, Intel developed the first microprocessor, the 4004, for use in a Japanese calculator. By building processing circuits of over 2,250 transistors onto a small chip, Intel duplicated some of the functions of a computer. In 1971, Intel placed the 4004 chip on the general market and was surprised at the demand for it. In 1972, Intel improved the design and produced the 8008 microprocessor, which was twenty times faster than the 4004. Individuals and small companies started to design and build small computers using the 8008.

The Scelbi 8H was the first computer based on a microprocessor advertised for sale. The ad appeared in the March 1974 issue of *QST, the Amateur Radio* magazine. The Scelbi was produced by a small company started by Nat Wardsworth and Robert Findley in Milford Connecticut. Prices for a Scelbi kit started as low as $440. There had been a previous computer kit produced by National Radio Institute which was not microprocessor-powered. It consisted of 52 IC chips, and it used slide switches as memory devices. Don Tarbell, who later designed the well-known Tarbell Cassette Interface, also designed a simple computer device which could add a 14-digit number by itself in 40 seconds.

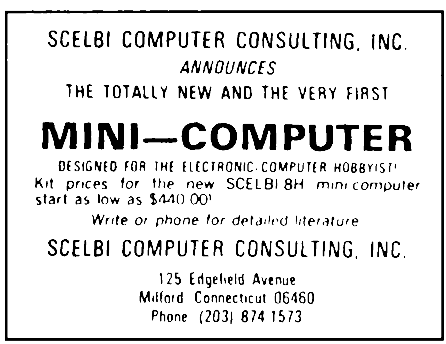
The first magazine project for building a computer appeared in *Radio Electronics Magazine* in 1974 and described how to build the Mark-8 Computer designed by Jonathan Titus. The Mark 8 used the 8008 microprocessor and was a real computer. Many Mark-8s were constructed from the magazine series, and Mark 8 user groups and newsletters appeared all over the country.

Nat Wadsworth with a Scelbi 8-H computer.

When the first issue of *Byte* magazine came out in September 1975, there were ads for The Mike Computer from Martin Research, which offered either a 8008 or an 8080 computer. The Mike had a keypad for programming and came with 256 bytes of RAM.

The RGS-008A Computer was also featured in an article. The RGS-008 was a 8008 computer which came with 1K of RAM but was expandable.

All of this activity took place before the advent of the Altair 8800, but it explains the built-up demand for a personal computer that exploded on the scene when the Altair became available.



The first personal computer ad, as it appeared in the March 1974 *QST*.

Dedication

Stan Veit's "History" has been published in the pages of *Computer Shopper* magazine over the past eight years and has always been a very popular series of articles. However, the limitations of the magazine format have always made it necessary to compress the subjects. For this reason, readers have written in ever since the magazine articles first appeared and urged me to publish it all in a book.

The pressure of publishing and editing *Computer Shopper* kept me from doing anything else until the magazine was sold and moved to New York City. As Editor-In-Chief, Emeritus, my duties mainly consisted of writing this history as a column. In accordance with my contract at the time of the sale, the material belongs to me although published in *Computer Shopper*. So I am able to expand it into this book.

The History is my history and that of the countless people who made the personal computer revolution that changed our lives in the last third of the twentieth century. Because it is my history, it probably leaves out some of the things that happened or sees them through my eyes, which might distort the events somewhat. This history is intended to give the reader the feeling of the times when, in a few short years, the personal computer appeared and grew to be a mighty force for change.

This book is dedicated to Glenn E. Patch, founder of *Computer Shopper* and to my wife Dede Veit (Lucretia Angela Maria,) who always stood at my side through it all. I could not and would not have done it without her.

I also dedicate this book to my wife's parents, Emil and Elizabeth Olivet, who believed in me and stood beside me in every way. They were the most loyal and loving parents to their children, their children's spouses, and their grandchildren. They treated me like one of theirs, and I loved them.

STAN VEIT'S HISTORY OF THE PERSONAL COMPUTER

1  COMPUTER CAMELOT ON THE HUDSON

It has been enveloped in the mists of time for more than a dozen years, but to those who worked there, or bought there, or who just wandered in, it was a magic place, a Camelot of Computers. Camelot, to us, was the Computer Mart of New York, the first computer store in the East and only the second one in the whole world. It was a place people never forgot. Started in the back of a toy store on New York's Fifth Avenue, it grew so quickly that the customers and shoppers filled the entire floor and interfered with the sales of Barbie dolls and wind-up cars.

This was in the Spring of 1976, when microcomputers were so new that people were first hearing about them, and so they came to Computer Mart to see something completely new and wonderful. Crowds of curious people flocked to the Computer Mart to see these new little computers, and enough of them bought computer kits so that the business could soon afford to move to less crowded quarters on Madison Avenue and 30th St. This is the place that people think of as Computer Camelot.

The new Computer Mart was a big store that had been a textile wholesale display room. It was really two stories high and one story deep. Overlooking the main floor was a balcony that became the working space for my wife Dede, who during the day was a teacher of emotionally handicapped children. After three o'clock, she was the real ruler of the store. Dede had the perfect training and experience for handling the

computer nuts who worked in the store, or who just hung out there. Looking over the edge of her balcony, she missed nothing, but said little unless she was outraged by the goings-on below. Usually, she enforced her dictates through a word from her associate, the formidable but gentle Barbara Learnard, who was also a teacher.

The computer showroom and the book department were on the main floor. Here, on raised platforms, were the various computers sold by the Computer Mart. In glass cases against the wall were displayed all kinds of circuit boards that plugged into computers to make them do wondrous things.

The Computer Mart sold IMSAI 8080s, South West Technical Products 6800 and Processor Technology, typewriter-sized SOL computers, and Apple Computers. The brand new Apple II computers were always a center of activity, as was the big Compucolor where games were always in progress. Each type of computer had its devoted adherents, who would defend with religious fervor its claim to be the "best."

At one end of the store was the book and magazine department, which was always filled with many browsers and a few customers. In those days, the newsstands were not packed with computer magazines. In all of New York City you only could buy *Byte*, or *Creative Computing*, or *Dr. Dobbs* in the Computer Mart, and there was no such thing as a "back issue." Once a magazine passed its cover date, it became much more valuable, and therefore we raised the price.

Collectors searched for a missing issue of their favorite magazine because they did not want to miss an issue. A complete collection of *Byte* magazine was worth its weight in dollars, but no one would think of selling it!

In addition to the magazines, the Computer Mart also carried one of the largest stocks of computer books in the city. These were not books about personal computers and software (there were almost none of those at the time.) The computer books in the shelves were serious and mostly very technical books. When someone came in and one of our clerks showed them how a microcomputer worked, the clerk would sell them a copy of Adam Osborne's *Introduction To Microprocessors*. The Computer Mart of New York was

Book and magazine section at The Computer Mart.

Adam's largest retail customer.

The income from the books and magazines was a very substantial part of the store's business and the key to its survival. There were not enough computer sales at first to pay expenses, even though the store could have sold more computers.

How It All Began

My office was behind the showcases, at the back of the sales floor. I am Stan Veit, Storekeeper, the person who ran the entire business (it was actually owned by Dede, my wife.)

I had been a technical writer in the aircraft and computer industries, working for such companies as Republic Aviation and Bell Labs. In 1975, I worked for a large computer timesharing company, writing their user's manuals. In spite of the fact that I won awards for their manuals from the Society for Technical Communications, when I finished the manuals for all of their current systems, they laid me off. It was one week before Christmas in 1975, and I had never been fired from a job before. Both the loss of my job and the timing angered me, and I declared that I would never work for anyone again.

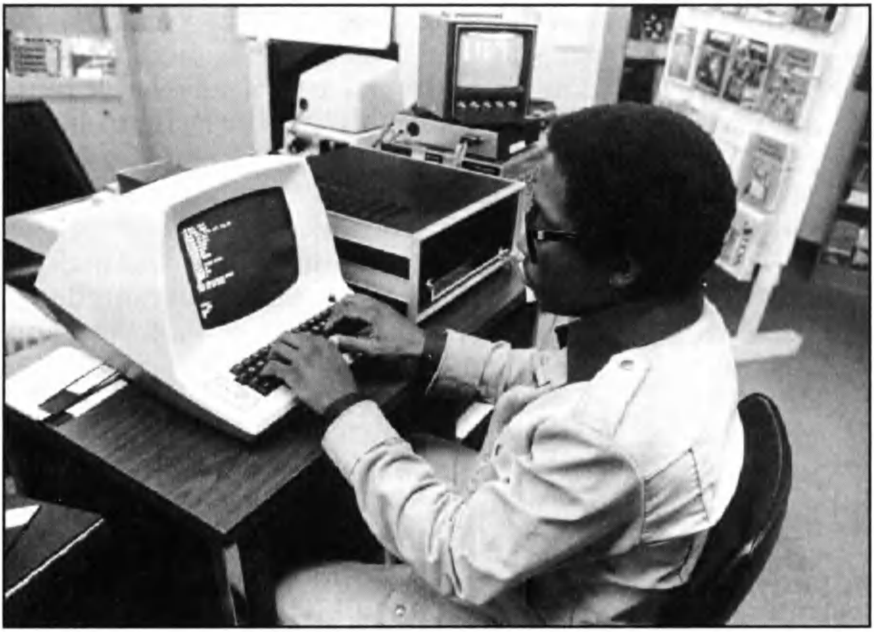
Dede had her school Christmas vacation, so we went to Florida with her parents. This gave me some time to think about what I would do next. One idea kept coming into my head; I had read about a couple in Southern California who had opened a store to sell computer books and Altair Computers. Actually, Dick Heiser ran the store while his wife, Lois, worked to keep them eating. The idea of a store front selling computers was completely new, and it got a lot of publicity as the "world's first computer store."

This all sounded good to me; I loved books and computers, and, of course, New York City also needed a computer store. Besides, my wife had a good job, and was willing to help in the store and, more importantly, was willing to support the both of us.

I made up my mind to investigate the computer store idea, but meanwhile we came back from Florida, and I started to look for a job. While job hunting, I looked for a location for a computer store, but I was not convinced that we could actually do it. I had time to look for either a store, or a job, because I had gotten a freelance assignment to write a manual for the Warner Timesharing System, and I knew that I would have some money coming in before I went broke.

One night, Dede and I were traveling out to Long Island to attend a meeting of the newly organized Long Island Computer Association. We were crawling on the Long Island Expressway when, suddenly, Dede said, "Stan, look over there!"

I looked. There was a store selling hang gliders, right in Queens, right off the Long Island Expressway!



Bob Williams using an Alpha Micro at The Computer Mart in 1978.

"You should do it," Dede said.

"Do what?"

"Open a computer store. If that guy can sell hang gliders alongside the Long Island Expressway, you can sell computers in New York City!"

I could never understand this kind of feminine logic, but I firmly believed that she was never wrong. I made up my mind to get serious about opening a computer store in New York City.

Remembering that someone had told me that there were three things that were important in the retail business, Location, Location, and Location, I decided to look for space right in the heart of midtown Manhattan. As a boy, I had been an avid model airplane hobbyist, so I went to see the Polk brothers, who owned Polk's Hobby Department Store on Fifth Avenue and 30th St. I ended up talking with Lewis Polk, the son of one of the brothers. He managed the retail end of the business, and it just so happened that there was a small space on the ground floor of the five-story hobby store. This

space had been leased to a magician, who ran a magic store as a concession. The magician had recently died, and the space was vacant. I could rent the space for a reasonable rent. I think Lewis Polk gave me the chance because he himself was interested in computers. That is the way we got into business.

Trying to decide what computers we should sell was not too hard; there were only a few products to pick from. The MITS Altair was the most popular, but when I called Ed Roberts of MITS, he told me that he had just granted the exclusive Northeast territory to some people in Boston and that I would have to deal with them.

Meanwhile, I was attracted to a computer called the Sphere that was made someplace called Bountiful, Utah. According to their ads, the Sphere was the only desktop computer that came with a built-in keyboard and video display. To my mind, it really looked like an office machine. All of the others looked like lab instruments with lots of front panel lights and no video screen at all. The Sphere Company was delighted to get a New York City dealer, and sent a representative to speak with me. The upshot was that I ordered a factory-built machine for display and several kits to sell.

The Sphere was a Motorola M6800-based computer, and someone told me that I should also have an Intel 8080-type computer in the store, so I contacted Dick Brown in Boston, who was the person that had obtained the Altair distributorship from Ed Roberts of MITS. I flew to Boston and met Dick and his partner. They picked me up at Logan Airport and took me to their lawyer's office in Boston. It was very impressive. They explained that they intended to open stores all over the east coast, either as franchises, or as partnerships with the store-operator.

"We understand you want to sell computers in New York City and are interested in us selling you a franchise," said Sid Harrigan, Brown's partner.

"Not exactly," I answered. "I am going to open a computer store in New York, and I am here to find out if I can do business with you and sell Altair computers. What are your terms for a franchise?"

"Well," Harrigan replied, "there is a $10,000 franchise fee,

Original location of The Computer Mart in the back of Polk's Hobby Store in New York at 314 5th Avenue. This photograph was taken in 1976. Kelvin Smith (l) was the manger, shown here with an unidentified customer.

and you pay 5% of your gross to us."

"What do I get for all this money?"

Sid beamed. "You get the exclusive right to sell Altairs in New York City and the use of our Computer Store name plus our help, advertising, and accounting systems."

I barely had $10,000 left after ordering my Sphere computers. I had no intention of giving it to anyone. My idea was to buy Altairs from them for a small distributor's mark-up. I was not interested in paying to work for anyone else! I politely told them I was not interested in a franchise; I wanted to run my own business.

"We are going to open a big store in New York to sell Altairs. It will be tough competition for you."

"That's right," I said. "It sure will be, but New York is a big place, and I think there will be a little business left for me."

I left Boston and flew back to New York with some trepidation; I really didn't have as much confidence as I

showed. I was a big bluff.

The next day, I found an ad in Byte for a new computer called the IMSAI, made by a company called IMS Associates in California. This was an 8080, and used exactly the same bus as the Altair; in fact it could use the same plug-in boards. It looked really professional, with a red, white, and blue lucite front panel, big bright lights and large bat-type switches instead of the little toggle switches and tiny lights on the Altair. IMS advertised that the IMSAI had a 20- ampere power supply and a heavy metal case. To me this machine looked as good as a DEC PDP-8! Little did I know that the machine in the ad was the only one that existed.

I rushed to the phone and called IMS Associates. "I am Stan Veit of Computer Mart of New York City. We are the biggest computer store in New York City (the only one!) and I may be interested in selling your machines if I can get a good deal."

I spoke with a man named Bill Lohse, who told me, "Mr. Veit, we have the best computers on the market and we will be glad to have your store as our dealer."

"What are your terms?" I answered.

"Well, we are not exactly set up to deal with stores right now. Our advertised prices are very low, and we can only give you 20% discount if you order COD. However, if you pay in advance, we'll give you an extra 5%."

" How about Net 30?" I asked.

"That's what we would like, too," the sales manager answered, "but we can't afford it now."

Well, at least they were frank about it.

"How do I know you will ship on time if I pay you in advance?"

"You don't, but frankly we want to have our computers on sale in New York City, because we are trying to raise money on Wall Street. You also have to agree to buy 50 computers during the year."

"Sure, I will sell a lot more than that," I boasted, knowing if I couldn't, I would be out of business anyway.

I took the chance and sent IMS a certified check for ten computer kits using almost half my available capital. That was one of the luckiest things I ever did. A week before I opened the store, my IMSAI computers were there. The Sphere


Second location of The Computer Mart at 314 Madison Avenue.

almost never worked, and the kits they sent me were never complete. I only sold one Sphere in all the time I was in business and that was to Watson Labs of IBM. No wonder it took them almost five years to come out with their own personal computer.

Six months later, the Computer Mart of New York was a going institution. We had so many people crowding into the little space I rented that Lewis Polk could not sell his dolls and toy cars that occupied the rest of the floor. He wanted me to move my store into the basement of the building and gave me an ultimatum either to move down or get out. Since I needed more room anyway, I went out looking for a store and again luck was with me. We moved from 500 square feet in Polk's Hobby store to 8,000 square feet on Madison Avenue, and the store soon became packed with computer nuts and just curious people, almost every day.

The first ten IMSAI's sold so fast that I hardly had time to assemble a kit for a store sample. The IMSAI 8080 became our salvation and the best computer of its type ever built. In fact,

we used my original Altair as a sample, and when a potential customer couldn't make up his mind between the Altair and the IMSAI, we put them side by side and let them compare. They always bought the IMSAI, which was much more impressive and also cost less.

Our marketing method was simple. The customer would put down one third of the price, plus shipping costs, and I would put their name on a list. When the computers came in, I would call them and they would come in and pay the balance, plus any other boards they bought. If the person was not able to come up with the money, I would either refund their money, or put their name down for the next batch and give their computer to someone else. Very few people ever asked for their money back. As soon as I had enough money for another batch of computers, I sent it to Imsai. Neither I or my wife drew any money from the store. We paid the rent, telephone, and we did pay our regular help in the store. We paid other expenses out of income; the rest we sent to California for more computers. We lived on my wife's salary as a teacher. My experience was only one example of the explosion in the microcomputer industry.

The Computer Mart People

The first week after the store opened, a strange young man came in. He had an unkempt beard and needed a hair cut. "I met you at the New York Computer Club. My name is Dave Levine."

I didn't remember him. I had met so many people at the first meeting of the club, and most of them were a little strange.

"What are you doing?" he asked.

"Trying to learn 6800 machine language to program the Sphere," I replied.

"Here, let me look at that," Dave said. "Do you know 6800 machine language?"

"No, but I have an Altair, and I learned that machine language."

I gave him the books, and the next day he came in with a program he had written to put messages on the screen.

We now had a working computer. Of course when you

turned off the power, the program disappeared. It also disappeared when you hit the keys on my cash register, so we kept the drawers open and hid the money elsewhere. Dave started to come in every day, and automatically became my first employee and technical expert. David and I worked together for years until I joined the staff of *Popular Electronics Magazine.*

Dave's family was "carney." His dad, Milton, had been a talker in a sideshow and now owned a used furniture store, while his mother, Lorna, ran an antique shop stocked with the more attractive merchandise that his father bought. Milton had a truck with an ad on the side that read "Milton's Store–Milton Buys Used Furniture, Milton Sells Fine Antiques." David had a horror of ever working a "straight" job, and he would come in at 11 a.m., take a lunch hour, and leave by 4 p.m.. However, if he felt I really needed him, Dave would work around the clock. The decision had to be his. I put up with him because he was a genius with computers and could interface a computer to anything. Besides, I liked him!

The second person who worked in the Computer Mart was Bob Arning, exactly the opposite of Dave. A computer programmer, Bob had built an Altair and was completely involved with the idea of having his own computer. A quiet, well-mannered, reserved person, Bob was thought by some to be somewhat of an elitist. Perhaps he was, but he was exceptionally competent with computers. Bob came into the Computer Mart with a proposition. He wanted to work in the store for nothing to see if he liked it and if we got along. If it worked out, he would invest money and have an interest in the business. Bob was disappointed that we didn't sell the Altair but he could live with that. I liked Bob, and knew I could use his technical ability, so I agreed. I could certainly use more money. We had to either pay cash in advance or COD for everything, and it was a strain on our limited resources.

Bob was one of the first people to get a cassette interface working. The use of an audio cassette was a great improvement over punched paper tape for data storage, but it was very hard to get it working consistently. He was also one of the first to use his computer to make music. We got along very well until Bob went to the first MITS Altair World Meeting and

met Dick Brown. When he returned, he told me that he was going to become Brown's New York franchiser and open a branch of the Computer Store. He really felt that the Altair was much better than any other computer, and that Computer Mart couldn't compete. There was no convincing him otherwise, so I said good-bye and wished him good luck. He opened a store on West 39th Street, between 5th and 6th Avenues, and we became friendly competitors.

When I visited Bob's store, I observed that it was completely unprotected, and urged him to do something about it. I had not only signed up with a security company and installed an alarm, but I had installed metal gates around our big windows. Bob never listened to my advice, and, one weekend, thieves broke into his store and took just about everything of value. I felt sorry for him because he simply didn't understand what it was like to be in business in New York City. Soon after, Bob left his store, and Dick Brown found someone else to take over.

Joe Bernard showing a Processor Technology Sol computer to a customer. We also sold a lot of computer-oriented T-shirts, some of which may be seen hanging behind the computer above.

The new Computer Store was really never much competition for us because MITS insisted that they only sell Altairs, and they could not supply enough of them to sustain a business. MITS had come out with the Altair Model B, which was an excellent computer, and would have been a real competitor to my IMSAIs if Bob could have kept them in stock. In fact, they helped my business because I sold expansion boards made by Processor Technology that were superior to those made by MITS. Most of the Altair owners came to us for memory and I/O boards, and I made more on the boards than I did on a complete computer.

Another employee was Kelvin Smith. My wife had previously run a "Stay In School" program at a Settlement House on the lower East Side, and one of her pupils was a young black man named Kelvin Smith. He kept in touch with her after the end of the program and became a close friend. When Kelvin heard that I was going to open the store, he brought me some money and told me he wanted to invest in the store. When we had to leave the store on a business day, Kelvin would come in and take charge for us. It turned out that he was an excellent salesman, and I talked him into coming into the business as my manager. He was impulsive and outspoken, but for our situation he made an excellent manager, and I could trust him with the money and the business. When he left to go back to college, I sorely missed him.

His replacement was Josef Bernard. Most of our employees were hired in the same way; someone came into the store because they were curious about computers, liked what they saw, and started to hang around the place talking with other computer fans. Soon they were giving advice to others and selling my computers. This is the way I met Joe Bernard. He hung around the store and was very helpful. Finally he got up the courage to ask me for a job. Joe was different from most of the characters who hung out at Computer Mart. He was mature, business-like, and he spoke several languages. He was just what we needed so I hired him to replace Kelvin as manager. Years later, Joe, who was also a Ham, became a writer for *Radio Electronics Magazine,* and when I left *Computers & Electronics Magazine* to join *Computer Shopper,* he took my place as Technical Editor. Like all the

Computer Mart people, we became fast friends for many years.

Ken Stamm, who became one of our most important employees, started when he was a student at a upper class prep school in New York City. Ken's main interest in life was computers, particularly South West M6800 ones.

He started hanging around the store after school, and soon was on the phone with South West ordering all kinds of things. "Don't worry, you'll sell this stuff. People can't get it anywhere else."

Before long, he was running the entire South West product line in my store. One day, a lady with a strong French accent came to see me. She was Ken's mother and wanted to know where he was going every afternoon and why he was neglecting his school work. We had a frank talk, and she told me that she wanted to take him back to France that summer, but he was in his senior year, and if he failed he would have to go to summer school. That would endanger the trip and his getting admitted to college next year. I told her I would help and I had a talk with Ken. It was simple, I told him–no pass school, no computers, no job, no Swits!

That did it. Ken still showed up every day, but now he brought his books. With the help of some of the other geniuses that hung out, he passed all his subjects and went to France that summer. I really missed him until he came back at the end of the vacation. Ken remained in the Computer Mart as long as we were in business. If you came into the store seeking to buy a computer, and Ken waited on you, the odds were that you would buy a SWTPC 6800 system.

Joe Sanger was a medical student at N.Y.U. Medical College, which was near our store. He had a degree in Electrical Engineering but had decided to become a doctor. He was completely absorbed in computers, and spent so much time in our store, the school warned him that unless he attended more classes he was danger of flunking out. However, he always passed his exams with marks at the top of the curve. He had recently been married, and his bride also objected to the time he spent "playing" with computers. Joe

The fact that people could walk into The Computer Mart and actually get their hands on a computer was a big attraction. There was no other place in New York where you could even see a personal computer, much less *use* it.

loved to build computer kits, and he could solder the motherboard of an Imsai, which had 22 connectors, each with 100 pins, while carrying on a conversation. His work was as precise as if it had been done by a wave-soldering machine, and he never caused a solder-bridge. Joe would have made a wonderful surgeon, but at one point he decided he did not like taking care of sick people and went into Radiology. When he graduated, we lost our best computer kit builder.

Jay Cotton was an instructor at the U.S. Coast Guard Electronics School on Governors Island in New York Harbor. He was also a intense computer hobbyist, and he used to spend much of his free time at the Computer Mart. One thing we lacked was a good service facility, and Jay provided that by taking the repair work back to the School with him. He and his fellow instructors repaired computers for me in their free time. This provided our store with the best equipped service lab in New York City. Jay also built "factory built" computers. At that time, all the computers we sold only came as kits. If a customer wanted a "factory built" computer, we built it for him. Many hobbyists financed their hobby by building computers for our store.

Mike Alpert was an accountant who had become bitten by the personal computer bug, and came into our store to see what was going on. He fell into the hands of Ken Stamm, and of course ended up buying a South West 6800 kit. Mike tried to build the kit, and made such a mess of it that it was impossible to fix without replacing many parts. In the course of his many visits to the store, we became friends. As Mike Alpert became more familiar with us, Mike realized that the Computer Mart needed two things, money and his services. He therefore became my partner and accountant. It was Mike who arranged for our finances and took all of those worries off my mind. I relied upon his business advice as long as we were in business, and I still do.

Michael Lewis was a young man who came to the store to buy an Alpha Micro Time Sharing computer, and became a friend. He was a brash young man who was determined to

Joe Bernard, store manager at The Computer Mart, putting a board into an Imsai 8080 computer.

start a software company to develop Alpha Micro software. Eventually we leased a floor in a nearby building as Mike Alpert's office and as a show room for Alpha Micro systems. Michael and his crew moved in and started to develop software under the name Dravac. His database, ANDI, later became the standard one for Alpha Micro systems. Mike brought his own cast of characters with him, including his girl friend, Suzy, whom I hired as my Secretary. Suzy later became a part-time punk rock singer, and her purple hair and mini skirts greatly enhanced the crew of colorful people who inhabited the Computer Mart. Bob Williams was one of

Michael's crew. He eventually became a Computer Mart Irregular.

The Computer Mart Irregulars were people who frequented the Computer Mart in those early days. They often worked part-time and filled many functions. Some did custom software programming, some sold machines, and others just answered questions and generally waited on customers. Many well-known people in the computer industry such as Nick Anis, computer book author, got their selling experience working part time in the Computer Mart of New York. I could thus use the services of people who also worked for some of the largest computer and programming companies in the world.

Selling computers in our store included educating the customer as well as selling him. After a while I developed a collection of materials and talks, and would speak before groups who were interested in learning about these new gadgets. I spoke to bankers, insurance agents, and accountants. Most of these speaking engagements occured after I was invited to speak on several radio and T.V. talk shows in New York. I also started to write for magazines and eventually wrote one of the first personal computer books, *Getting Involved With Your Own Computer,* with Les Solomon as co-author.

The Night We Stopped Traffic

One day, Les Solomon, Technical Director of *Popular Electronics Magazine,* came into the store and showed me a new board that could produce color graphics on the Imsai computer. It was called the TV Dazzler, and when Les showed me what it could do, I just had to get one for my store. The board was made by a new company called Cromemco, organized by Roger Melen and Harry Garland from Stamford University. The Dazzler was actually two boards connected together that could produce vector-generated color graphics that were very far advanced for 1976. Storing any video image in a computer takes a lot of RAM memory, and storing color images takes even more memory. Personal computers of 1976, such as the Altair or IMSAI with 8K or 16K of RAM

memory, were considered to have large memories.

Most of the computers in use at that time did not have video terminals, but were connected to Teletype machines which acted both as printers and memory input devices. To produce any kind of graphic image on a CRT took such large amounts of memory, all that could be managed was block-like figures. (Remember the early video game machines?)

The TV Dazzler produced graphics that were also very crude, but they were in color. One program for the TV Dazzler generated a sensational ever-changing color display. This was called Kaleidoscope, and the color video display was exactly like looking through a rotating color kaleidoscope, except it was shown on a large color TV and the patterns constantly changed, seemingly never repeating exactly the same design.

When I received my TV Dazzler kit, I had it assembled and installed into an Imsai 8080 Computer. In those days, color video display monitors were something that only existed in TV stations; they cost thousands of dollars and were far out of our range. We used a regular 19-inch color TV and connected it to the computer through a little board called a PixieVerter. This was a sub-miniature TV station which added RF to the video signal from the Dazzler. You connected the output of the PixieVerter to the TV set's antenna terminals, and the image appeared on your TV. Of course, the PixieVerter was illegal to sell for this purpose, so it was sold as a kit and was supposed to be used to generate signals for a TV repairman.

When we got the Dazzler hooked up and running, we loaded the program in from a paper tape run through the tape reader on my Teletype®. Then we accessed the memory address for the TV Dazzler. All at once the TV screen displayed the moving, vivid colors of the kaleidoscope. Nobody could take their eyes off the images on the screen; it was hypnotic.

Then I got a real bright idea. My computer store was still in Polk's Hobby Department Store at 5th Avenue and 32 St in New York City. This location, two blocks from the Empire State Building, on 5th Avenue, was a very busy thoroughfare both day and night. I thought of a great way to draw attention

One of the earliest popular brands of personal computer equipment was SWPTC. The Computer Mart was the New York dealer.

to my store! One evening we put the TV set in the window. It was connected by a long piece of coaxial cable to the IMSAI computer in the back of the store, which had Kaleidoscope loaded into the TV Dazzler. We left the computer running when the store closed, and went home.

Imagine that you are a motorist driving down 5th Avenue in New York City at night. All of the stores are closed. It's pitch black, except for the street lamps. As you approach 32nd St., you see dazzling kaleidoscope patterns in bright colors, playing across the face of a TV tube in a store window. Even a jaded New Yorker was sure to stop and see what was making this display. Naturally, when you stopped to see what was going on here, so did everyone else. It did not take long to attract a large crowd of rubberneckers, and this stopped traffic completely, creating a big traffic jam on one of New York's busiest avenues. Soon, the police came to unscramble the traffic jam and they quickly saw what was causing the

problem. Thinking that the pictures had to be coming from a TV broadcast (there were no VCR's in those days,) they called up all the local TV stations to find out who was broadcasting the images. The TV stations knew nothing about it. The police soon realized that the display had to be generated by something inside the store.

First they called the owner, and then the manager, of the store. The manager had to come downtown all the way from the Bronx. He had to open the store, turn off the alarm, and then he disconnected the computer by pulling the power cord out of the wall. The next morning, when I came to work, he had a few choice words to say to me about the window display. If I ever pulled anything like that again, I was finished with Polk's store!

It was worth it. We got a lot of publicity, and people became curious about the little computers that could cause a big traffic jam. However, soon after that episode I moved into new quarters at 30th Street and Madison Avenue, enlarging the Computer Mart of New York from 500 square feet to 4,000 square feet.

The XYZ Computer Company

I had a steady flow of visitors who wanted to open computer stores, and came to see how it was done. Just by opening the Computer Mart, I became an instant expert. Of course, I realized that I was no expert, just lucky, but people came just the same. Hal and Harriet Sheer came from Westchester County to see me. Hal had gotten an idea to install computers in libraries for the public to use. His machines were to be coin operated and specially available to kids. Harriet was supportive of him but much more practical; she wanted to open a computer store, which they eventually did under the name Computer Corner.

Larry Stien came to see me about his idea to open a computer store in New Jersey. I suggested that he use the same name as my store. He first did business from his home, but later found a partner, Ari Golombo, who had money, and opened a store. The Computer Mart of New Jersey became a very successful store, and was both an associate and a competitor of ours.

The problem was that a lot of customers who came to our store ended up buying out of state from Larry to save the New York sales tax. We got some New Jersey customers, but there was not as much traffic in our direction.

I met Charles Dunning through Doug Hancey of Sphere, and it was just a coincidence that his store, which opened shortly after mine, was called Computer Mart of Boston. We became good friends, and other New England Computer Marts opened in Vermont and New Hampshire. We all became very loosely associated.

We had other out-of-state associates, mainly Larry and Betsy Chinnery of The Computer Workshop of Rockville, Maryland, and Bill and Angela Miller from Sunny Computers in Miami, and my close friend, John French of Computer Mart of Los Angeles.

At Larry Stien's suggestion, we formed the XYZ Corporation to enable us to buy together in order to meet competition from chains as they started to appear. We would also meet to discuss mutual business problems and find areas where we could cooperate.

2

RASHOMON: THE FIRST PC

Rashomon is a classic Japanese story (and great movie) about an incident during the lawless days in ancient Japan. It seems a Lady and her escort are set upon by bandits while traveling through a usually-deserted area. In the ensuing fight, everyone is killed. Unable to determine what happened, the authorities call in a famous necromancer whom, it is said, can raise the spirits of the dead. He is instructed to call up the spirits of the participants of the fight in order to find out what happened. Upon interviewing each spirit, a completely different story is told, and we never find out what actually happened.

The story of the first true personal computer is like that. It is only 17 years since the debut of the Altair 8800 computer in the pages of *Popular Electronics Magazine*, but everyone connected with it tells a completely different story. Truly, "Success has many fathers."

I was the first (and last) Computer Editor of *Popular Electronics* magazine, and I came on the scene after the fact, but as one of the few people who is friendly with all of the participants, I am as qualified as anyone to tell the story.

The principals in the story are Leslie Solomon, former technical director of *Popular Electronics*, who is often called "The Father of the Personal Computer" (Les himself says he was more like the midwife.) Arthur Salsberg, editorial director of *Popular Electronics*, who was responsible for publishing the articles that brought the Altair to the world, and Ed

Roberts, the president of MITS Incorporated, who designed and built the Altair. A supporting cast at Ziff Davis (publisher of *Popular Electronics*), and at MITS in Albuquerque, composed of Don Lancaster, Forrest Mims, and David Bunnell, who are well known in the personal computer industry, and a lot of people not so well known.

There are a few facts we are absolutely sure of and can set down as gospel truth. First, the Altair was not the first computer featured as a construction article in a national electronics magazine. That honor goes to The Mark 8 computer, designed by Jonathan Titus and published in *Radio Electronics Magazine* in July 1974.

Why, then, does the credit go to *Popular Electronics* and the Altair, which didn't come out until January 1975? I can think of two reasons: first, the Intel 8008 chip, used as a Central Processing Unit (CPU) in the earlier Mark 8, lacked some internal parts that are thought necessary to a microcomputer. Second, the Altair was offered as a complete kit, not just a list of parts to buy in order to make a computer. In those days it was almost impossible for anyone outside Silicon Valley, California, where the chips and other parts were made, to find the components necessary to build a computer. The 8008 microprocessor alone cost $150; the more powerful 8080 usually cost $300. In spite of these costs, Ed Roberts proposed to sell *Popular Electronics* readers a complete Altair kit for only $397. But I am getting ahead of my story.

Exactly how the Altair project got started is a major bone of contention. According to Art Salsberg, all the technical magazines knew about the development of microprocessor chips and they were all rushing to be the first to publish a computer construction project. Art says he had one of his contributors, Jerry Odgen, working on a microprocessor-based, digital, computer trainer article. Odgen had completed his preliminary work, but the project was not yet in publishable form. It was a "haywire mess" and needed to be cleaned up. When the Mark 8 article broke in *Radio Electronics*, Art Salsberg realized that the digital trainer was not good enough to counter the *Radio Electronic* article. He set about finding a better subject for a new project. Ed Roberts had written a construction article for a digital calculator, and the

The lead feature in the January, 1975, issue of *Popular Electronics* featured the Altair 8800. The editors called it "the world's first minicomputer kit," but it was really the world's first commercially available *microcomputer*. If you have this very collectible copy of *Popular Electronics*, hold on to it—the value will continue to rise.

magazine had offered a kit of parts to the readers. This project proved very popular, but now calculators were selling below the kit price, and it was dead. Ed Roberts proposed to Art Salsberg that he design a computer kit using the brand new 8080 CPU chip. This would be a major breakthrough, so Art sent Leslie Solomon to New Mexico to investigate and report back to New York.

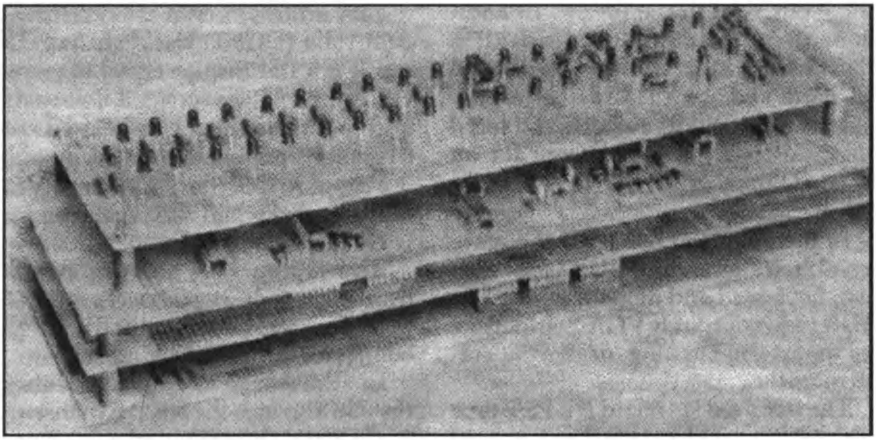
The Les Solomon version of the story was that he was traveling out west to visit his Indian foster child. He met with Don Lancaster and Forrest Mims, who wrote for the magazine. They introduced him to Ed Roberts, another contributor to the magazine. After a day of discussion, Roberts proposed the computer kit. Les told him that if the unit was attractive, did not look like a "hay wire rig," and it worked, he could get it placed on the cover of *Popular Electronics*, which would assure its success.

Another version of the story was told by Forrest Mims in the 10th Anniversary Issue of *Creative Computing Magazine*. In this version, Solomon was back in New York but knew that Roberts was working on a computer project. When the Mark 8 came out, Arthur Salsberg realized that he would have to publish a more sophisticated project than the stalled digital trainer from Ogden. He discussed it with Solomon, who mentioned that Ed Roberts was working on a computer. Art asked Solomon to call and find out if Roberts could get his project ready for a winter issue. Les Solomon called Roberts and was told that the project would be ready for the January issue. Later, Roberts called and said the computer would be housed in an attractive, multi-colored, Optima cabinet. With this, Art held up the Odgen trainer project, holding it as a back-up just in case Roberts did not deliver on time.

The important thing was that Salsberg and Solomon picked Ed Roberts and MITS to do the computer project, and Roberts was able to do it!

There are other versions of the story told in several other publications, but essentially these are the two main themes—Rashomon!

The key to the whole computer project was the microprocessor chip itself. The 8080 from Intel cost $300 in small

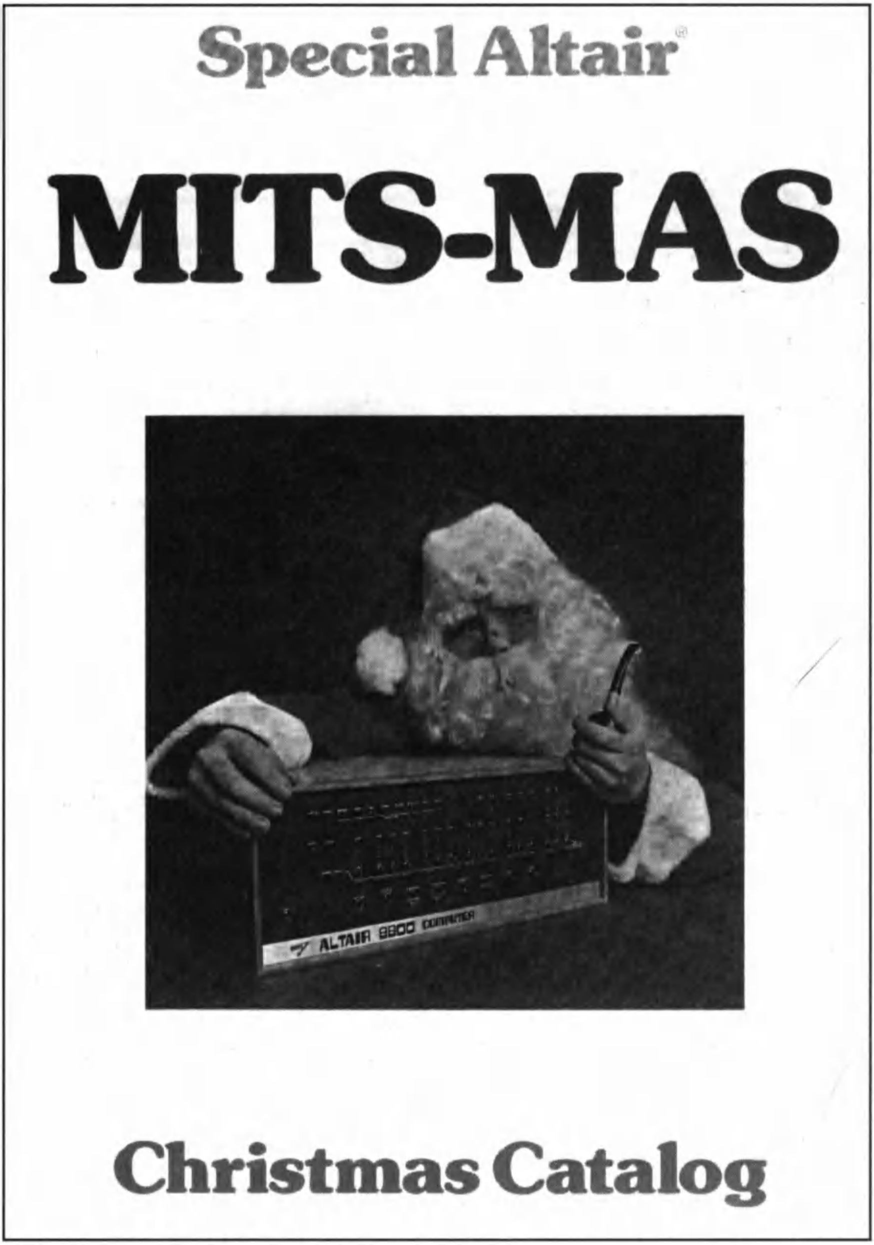


The photograph of the Altair 8800's circuit boards shown in that January 1975 article were not designed to plug into an S-100 bus motherboard as did later versions.

quantities; Ed Roberts was able to make a deal to get CPU chips for $75 in huge quantities (for that time,) providing he took chips with cosmetic defects. These are chips with surface defects that do not affect the electrical operation. This deal made the under-$400 kit price possible, but only if Ed could sell as many as 200 computers, which was his break-even point. This was an unthinkably large amount. Roberts was gambling that with the computer on the cover of *Popular Electronics*, enough of the 450,000 readers would pay $400 to build a computer, even if they did not have the slightest idea of how to use it.

Somehow, Ed Roberts and his small crew made the deadline, and shipped the computer to Les Solomon in New York via Railway Express, the normal, safe, and fast way to ship in those days. Only this time, Railway Express had a strike, went bankrupt, and completely lost the computer. It was never found.

To meet the deadline, Solomon had already started to write the first installment of the article, based on technical information supplied by Roberts and some photos taken before shipment. The Altair on the cover of the January 1975 issue of *Popular Electronics* was a dummy; there was nothing behind the front panel with its lights and switches. Salsberg



By late 1975, Altair was riding high. The first issue of the Southern California Computer Society's publication, *SCCS Interface*, featured the Altair 8800 and the 6800-based Altair 680 on its cover, and eight of the magazine's 32 pages were taken up by the "MITS-MAS" catalog.

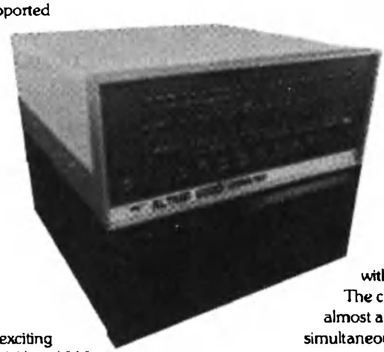
"PROJECT BREAKTHROUGH!

World's First Minicomputer Kit To Rival Commercial Models... 'Altair 8800'"

headline on cover of *Popular Electronics*, January, 1975

The Altair 8800 from MITS is now one of the most successful computers ever delivered. Thousands of *Altair 8800's* have been sold and are in the field where they are being used for an infinite variety of industrial, business, science and home applications

The *Altair 8800* is extensively supported by ongoing hardware and software development. *Altair 8800* interface and memory modules and *Altair peripherals* are inexpensively priced, yet among the highest quality in the business. Byte for byte, *Altair 8800* BASIC language software is the most powerful BASIC ever written.



Thanks to the success of the Altair 8800, building and programming computers has become one of the World's most exciting and fastest growing hobbies Local Altair 8800 Users Clubs have been formed across the United States and in such far away places as England and Japan.

Thanks to clean, efficient design and accurate, easy to understand assembly instructions, the *Altair 8800* is an easy kit to assemble. As an *Altair 8800* kit builder, you will have the satisfaction of successfully building your own computer and you will learn about the internal structure of digital computers.

As the owner of an Altair 8800, you will be backed by the technical expertise of the MITS Customer Service Department. You will receive the latest update information, programming hints, technical advice and general computer information on a monthly basis through a free subscription to *Computer Notes*. You will be in contact with other *Altair 8800* owners through the *Altair Users Group* and you will have access to the extensive *Altair 8800 Software Library*.

No other computer on today's market can offer you as much support as the Altair 8800.

Christmas Special

For a limited time only, you can be the owner of an *Altair 8800* with a 1,024 word memory module for just $68 a month! See back page of this catalog for all the details.

Altair 8800 Features

Built around the most successful (and many say the most powerful) microprocessor chip ever [the Intel 8080], the *Altair 8800* is a variable word length computer with an 8-bit processor, 16-bit addressing and a maximum word size of 24-bits. It has 78 basic machine instructions with variances over 200 instructions. The *Altair 8800* can directly address 256 input and 256 output devices and up to 65,000 words of memory.

Up to 300 peripherals can be interfaced to the *Altair 8800* without any additional buffering. The custom designer can interface almost any number of imaginable devices simultaneously. All *Altair* peripherals are supplied with software handlers to make interfacing easy.

The *Altair 8800* includes the CPU board, front panel control board, power supply (enough to power any additional cards), and expander board (with room for 3 extra interface or memory modules) all inclosed in a handsome, aluminum case complete with sub-panel and dress panel Up to 16 cards can be added inside the main case

Altair 8800 Prices

Altair 88C0 Computer kit (includes assembly hints, assembly, operator's, and theory manuals)		**$439**
Altair 8800 assembled		**$621**
Expander board (adds 4 slots)		**$ 16 kit**
	assembled,	**$ 31**
Cooling fan		**$ 16 kit**
	assembled,	**$ 20**

The MITS-MAS catalog insert had full-page ads for the Altair 8800 (above) and the 680. Other pages showed printers and terminals. Software offerings were few and expensive. Altair 4K BASIC was $150, Extended BASIC $350, and the Altair Disk Operating System $150.

and Solomon had stuck their necks out by a mile.

Meanwhile, back in Albuquerque, Ed Roberts had come up with a new design for the replacement machine. If you opened the January issue of *Popular Electronics* to read about the Altair, you would see a photograph of the lost prototype computer. In that photo, you can see that the computer was made of several boards stacked on top of each other and separated by spacers. There is no connecting bus at all. The boards were connected by ribbon cable. But when Ed Roberts built the new machine he included a bus board. This was a circuit board with 100-pin connectors. The mating circuit board had 50 "fingers" with electrical connections on each side of the board (making 100 electrical connections,) that could be plugged into a socket. This enabled the user to add additional circuit boards and thus expand the capabilities of the computer.

Because the Optima cabinet was so big, he provided for the addition of additional bus cards and built an 8-amp power supply. This was a very large amount of power for the time, and he never imagined it would prove too little to power all the features owners later demanded. The bus structure Ed Roberts invented was originally called "The Altair Bus" and later, the "S-100 Bus," a name Roberts hated because he felt it robbed him of the credit for his invention, and so it did. If you think about it, without the Railway Express strike and bankruptcy, we never would have had the S-100 Bus, and the foundation of a large segment of the personal computer industry which descended from it, including the IBM PCs.

The source of the very name "Altair" is also questionable. Les Solomon says that MITS tried to find a good name but couldn't agree and so called it the PE-8 (Popular Electronics 8-bit.) Solomon wanted to use a better name for the computer in his article. He asked his young daughter, who was watching Star Trek, what they called the computer.

"Computer," she answered.

"You are a big help," he told her.

So she said, "Why don't you call it Altair? That's where they're going this week."

And that's what they called it. Forrest Mims said the name came from two editors of *Popular Electronics* in New York.

One of them, Alex Burawa, who was an astronomy fan, said, "Its a stellar event, so give it a star name–Altair."

Again, Rashomon!

Ed Roberts added the numbers 8800 to the name because he intended to make later models. Thus, it became Altair 8800, and that's the name stenciled on the front panel.

The Altair articles ran for several issues of *Popular Electronics*, and as a result MITS was deluged with orders. To this day nobody knows how many computer kits were sold through the magazine, but Les Solomon told me he estimated over 2,000. That is more computers of one type than had ever been sold before in the history of the industry. Naturally, MITS was totally unprepared. They had hoped for 200 sales and received 2,000. Their small crew was totally swamped; they did not even have enough parts on order. There was no way they could deliver. However, when people were asked if they wanted their money back after 30 days, no one asked for a refund. They all wanted their computers–never mind about the money!

The flood of money being received at MITS catapulted them into serious business and they started to advertise in *Byte*, *Creative Computing*, *Popular Electronics,* and all the emerging computer magazines, selling even more Altair 8800s. In spite of slow delivery, people all over the country started to put together computers.

At one of the demonstration meetings held by MITS in Los Angeles, Dick Heiser became impressed with the Altair. He was able to persuade Ed Roberts to make him a dealer. Although Roberts did not have enough kits to supply the demand, he was forced to keep selling to keep the cash flowing. Heiser had a new idea about selling computers. With his wife, Lois, he opened Arrowhead Computers, a store selling computer books and Altair computers. Dick sub-titled his retail operation "The Computer Store" and this name caught the fancy of the press, giving him a lot of free publicity and inspiring many others to open computer stores.

What did an Altair buyer get for his $397 when he finally received the Altair kit? He got a box of parts, circuit boards, and some poorly written instructions. The manuals did improve, after Roberts hired David Bunnell as the Technical

Writing Department, but you still had to be an experienced kit builder to put an Altair together and make it work. If you became completely mystified by the instructions, there was a phone number to call—if you could get through.

For those who were afraid to even start building a kit, you could buy a factory-assembled Altair for $498, but you had to wait much longer for an assembled unit than you did for a kit. No matter which you bought, you received an excellent cabinet, and a front panel with the name ALTAIR 8800 stenciled across the front. You assembled the 8-amp power supply, consisting of a transformer, switch, fuses, some rectifiers, controller chips, and a group of electrolytic capacitors, inside the cabinet. Then you installed the bus card. You carefully built the front panel and CPU by inserting the parts into the tiny little holes, applying solder so that you did not bridge any of the connections. This was not a job for the inexperienced or careless. If you applied too much heat you could ruin the chips, or even raise the plated lands off the board. If you did not use enough heat, you got a cold solder joint which plagued you ever after, and your computer probably would not work.

After they were built, the front panel board and the CPU plugged into the bus board, which was made with 50 parallel lines (or lands) on each side and four groups of holes that intersected the lands. Unless you paid extra, you only got two 100-pin sockets to solder into the bus card because you only received two circuit boards, the CPU, and front panel. You quickly learned to buy the two additional connectors for $15 each and install them when you first built the computer, because you would quickly need them.

When you bought your kit, you got no memory board or input/output board. All the memory that came with the Altair kit was 256 bytes (no, not "K-bytes"). All you could do with this was to play a game called "Kill The Bit" which had to do with trying to guess which front panel light would come on and trying to flick the switch before the light went out again. Actually this was a real indication that your computer was working. There was hardly any other way to tell.

If you really wanted to use your computer, you had to buy memory boards. You could get a 1K memory board in kit form

Photo: Garry Reed

Altair brought computers to everyone. Many students in the late seventies first met computers by using an Altair 8800A as this young lady is doing in a photograph from the June 1977 issue of *Kilobaud* Magazine.

for $97 ($135 assembled), a 2K memory board for $145 ($197 assembled), or a giant 4K memory board for $264 ($338 assembled.) In addition to memory, you would need either a serial interface board for $119 ($138 assembled), or a parallel interface board for $92 ($114 assembled), or both. One problem you didn't know about until after you built your computer was how much it cost to get a terminal for your computer to communicate with. The ideal was a Teletype®. These cost about $2,000 new for an ASR-33, a model which could act as an input device and a printer. In addition, it could punch paper tape which served as a data storage medium and read paper tapes into the computer. Even at the price of $2,000, you could not get new Teletypes®, which were built under contract a year in advance. Used, re-built ASR-33 machines sold for $1,200 to $1,500. Video terminals called "glass teletypes" were just starting to appear and they were

beyond the dreams of Altair owners. MITS tried to build some terminals that hobbyists could afford, but they were not a success. Finally they made a deal to get some teletypes, without a stand and using their own interface, to sell to Altair owners for $1,500.

They also developed a cassette interface kit that worked with their serial board for only $120 ($174 assembled). This worked fairly well and was a big improvement over paper tape.

If you had 4K of memory you could run BASIC. This cost $150 unless you bought it with both a memory and I/O board from MITS. In that case it only cost $60. If you bought 8K of Altair memory, you could buy 8K BASIC for only $75; if you bought 12K of memory you could buy Extended BASIC (when it came out) for only $150. This was the famous BASIC written by Bill Gates (which is another story) and was not too bad a deal, except for the fact that the Altair dynamic memory boards did not work very well. The reason for this was that dynamic RAM needs to be electrically refreshed or it "forgets what it should remember." MITS took the refresh power from the CPU, a process known as "cycle stealing." Sometimes when the RAM needed refreshing, the CPU would be busy doing something else and the memory would be lost. MITS later replaced a lot of those early memory boards without cost, but the damage was done. People did not trust MITS memory boards, and bought static memory boards elsewhere.

If you did buy more than one memory board, you had to add at least another bus board and more connectors. The bus board they gave you with the computer kit only held four circuit boards. The CPU, front panel I/O board, and one memory board filled it completely. To add another bus board, you had to completely disassemble your computer, and solder 100 jumper wires to connect the new bus board to the existing one. Then you had to install the connectors into the bus board, making 100 solder joints for each connector. Finally, you had to solder the 100 new wires to the additional bus board. For every bus extender board, you had to solder 100 wires at each end. You had to be a soldering wizard to be a computerist in those days.

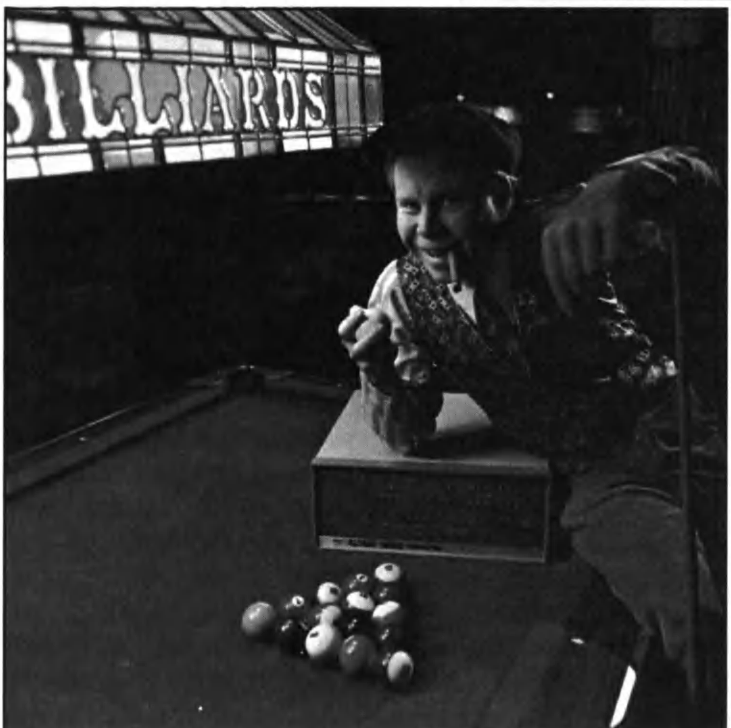
How About Software?

These were no operating systems to worry about. They came in much later, with floppy disks. There were operating programs, called Monitors, which did program loading, execution, and housekeeping, as well as some troubleshooting. There were also program loading routines called "bootstrap loaders." Getting software into the computer was somewhat complicated. First, you had to key-in a routine to initialize your I/O board. You did that by setting the front panel switches to represent a word in machine code (mostly octal). Then you pressed the Enter switch. You had to program the initializing routine word by word pressing "Load" after each word. Then you could load the "bootstrap loader" by reading in a teletype paper tape using the tape reader on the teletype, or an audio tape using a cassette interface. Next, you entered your monitor program, which was sort of a mini-operating system, again using the paper tape reader on the teletype, or the cassette interface. Now you were ready to load BASIC.

Everyone used BASIC in one form or another. Starting with 2K Tiny BASIC for the poor folks, and going up to Altair Extended BASIC (12K,) you had to use some form of BASIC to do anything. There was absolutely no application software in existence. BASIC programs were shared among users by publishing them in magazines or exchanging paper or audio tapes at clubs. Many of the first applications were simple games such as Hangman, Hammarabi, and simple forms of Star Trek.

So how did users get Altair BASIC (later Microsoft BASIC)? Simple. They invented "multi-user" BASIC, which in this case meant that one person bought the package, and ten others used it. Bill Gates and his partner, Paul Allen, had licensed their software to MITS on a royalty basis, and they were the ones who suffered. Gates sent an open letter to all the magazines, saying if computerists did not stop stealing his software, he would stop writing it. That did not work, so his solution was to get out of the bad agreement he had made with Ed Roberts. He then formed Microsoft to sell his software directly to users at a reasonable price. Bill Gates went

In the era of the personal computer's infancy—when ads were thrown together haphazardly by engineers (and showed it)—Altair ads were often refreshingly creative. The ad on the left from the back of the March 1976 *Byte* Magazine informs us that if Napoleon had only had an Altair 8800, things would have turned out differently. Below, several ads on the back of *Byte* during 1975 (this one is from the November issue) told us that Altairs were popping up in some rather unusual places. MITS was the leading personal computer company, and these and other ads reflected that.




ALTAIR 8800 COMPUTER

on to become the world's youngest billionaire.

What Ever Happened To MITS Altair?

In 1976 and 1977, MITS was at the top of the heap. They were selling the Altair 8800 A and B models, plus a small 6800-based computer and a full line of peripherals. MITS had dealers all over the country and they could easily sell everything they could make. They ran multi-page ads in all the magazines and had the largest exhibit space at all the computer shows. Why isn't MITS the biggest personal computer company in place of IBM or Apple?

During Altair's heyday in the late 1970s, the company offered a complete line of personal computers "off the shelf" and ready to go. It was the concept that fanned high the flames of the personal computer revolution. Now *we all* could have a *personal* computer!

The problem was that Ed Roberts was a much better visionary and designer than he was a businessman. Starting with an organization of three people, he built a big company in a very short time. No one can take away from him the fact that he built and shipped more computers of one type than anyone else. He also developed new products at the same time he was setting up production, not an easy task. But Ed Roberts knew nothing about marketing and he made some serious mistakes.

Roberts gave Richard Brown the entire east coast of the United States as an exclusive territory. Brown and his partner, Sid Harrigan, planned to franchise computer stores all over the eastern territory under the name "The Computer Store" (which Dick Heiser had failed to register.) However, they sold only a few franchises. Meanwhile, other stores opened which would have sold Altairs if they could have gotten them. Instead they sold IMSAIs and South West Technical Products computers because that was what they could get. Thus, Roberts built up his competitors instead of keeping them out of the market.

In addition, Roberts took the automobile dealerships as his marketing example for Altair dealers. He insisted that his dealers could only sell Altairs. He was credited with saying "Ford dealers don't sell Chevies, so Altair dealers will only sell Altairs." However, he could not supply enough computers to keep the dealers in business. In addition, MITS continued to sell directly to end users even after their dealer network was in place. MITS was actually in competition with the dealers and could not stop because of cash flow problems. At that point, Ed Roberts' company could have attracted venture capital, or even gone public to raise money, but he did neither.

To make matters worse, MITS was in competition with two marketing geniuses, Bill Millard and Ed Farber of Imsai, who opened all the dealerships they could. Anybody who would put up $2,500 and promise to buy 25 computers in a year could become a dealer. Imsai actually delivered what they promised. When I opened my store, The Computer Mart of New York, (the first store on the East Coast) the first ten Imsai computers were there waiting for me, exactly as

promised. I got all the computers I could sell, as long as I paid cash in advance for them. But the story of Imsai is another chapter.

The plight of the Altair dealers, and the internal cash flow problems became too much for Ed Roberts, although he could have worked them out. When Pertec, the disk drive manufacturer and principal creditor, offered to buy MITS, he sold out and retired from the computer business.

Pertec was a typical big business organization and did not understand the free-wheeling culture of MITS and the personal computer industry. However, it did know that MITS was selling a lot of its disk drives. Pertec saw MITS as a way to get into an emerging market. The businessmen who ran Pertec felt that the Altair name was tainted with the "hobbyist" designation. They wanted Pertec to be thought of as a "business computer company." They, therefore, dropped the name, which was the greatest asset they had, and the Altair disappeared from the market. Later, Pertec itself was brought by Adler of Germany and was absorbed by its parent.

The Altair did not disappear from the thoughts of the computerists and neither did the hardware they used. People hung on to their Altairs as old friends. Nothing will ever exceed the thrill of seeing the sign-on for BASIC printed on the teletype for the first time and reading the prompt "READY."

Ed Roberts went to Georgia and attended Medical School and also became a farmer. At one point, he got back into the computer business, producing a series of modular components to be used as building blocks in laboratories and engineering projects. This business did not survive in the face of off-shore competition.

3

IMSAI, THE NEW FOUNDATION

Although the MITS Altair 8800 was the first practical personal microcomputer and started the industry, credit for spreading the personal computer revolution must go to another company–IMS Associates and its product, the Imsai 8080 computer. While it was not strictly a clone of the Altair, this machine adopted the bus structure of the Altair and used interchangeable plug-in circuit boards. This commonality and the availability of the Imsai assured the dominance of the Altair (S-100) Bus.

IMS Associates was started by William Millard as a computer consulting company, whose most important consulting project was the development of a computer system for an automobile dealer. In an effort to reduce costs, Millard became interested in the new microprocessor chips being manufactured by Intel, and the possibility of networking many of them into a powerful computer system he called Hypercube.

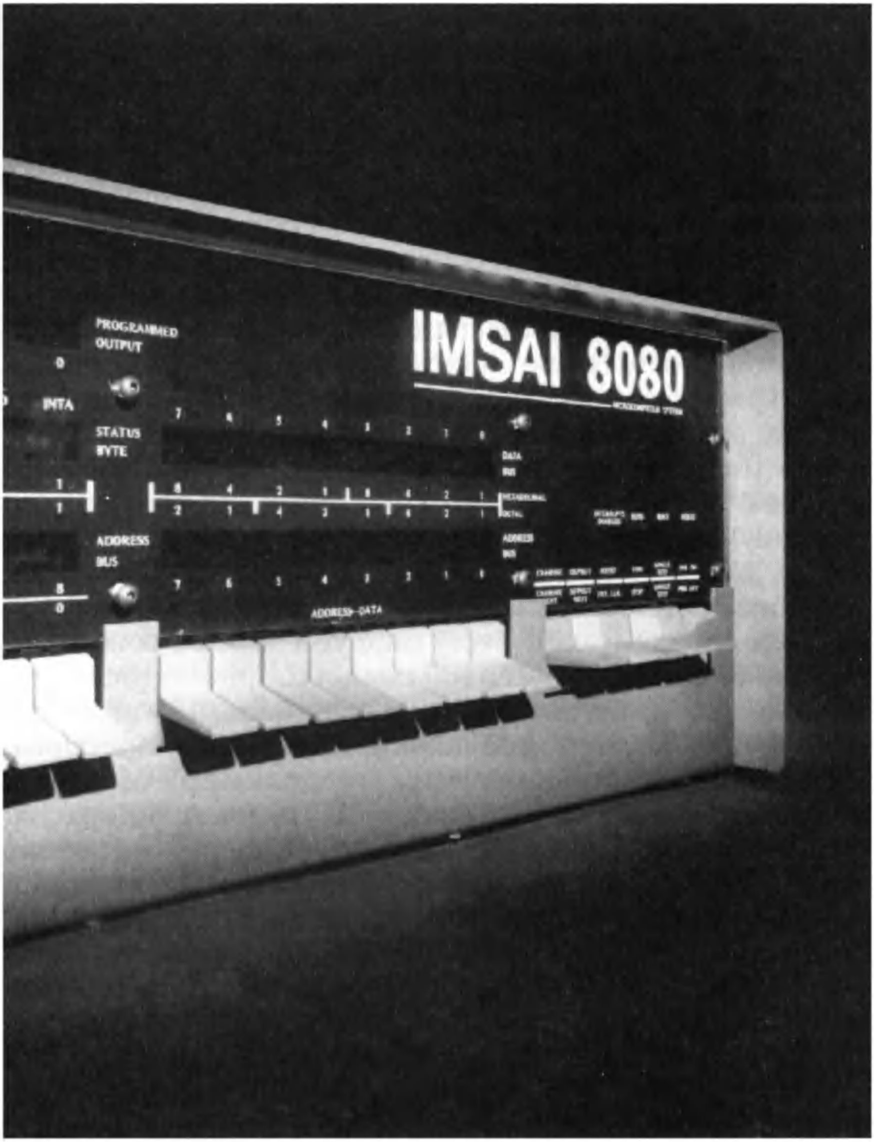
When the Altair article broke in *Popular Electronics*, Millard and his associates tried to order some Altairs to try out this idea. They immediately ran into two problems. First, MITS wanted payment in advance, and second, they couldn't promise to deliver the order for at least 90 days. IMS Associates couldn't get the money unless they could show their customer that they had a solution to the problem, and they couldn't wait 90 days. Millard did manage to borrow an Altair

to examine, and he and his associates became convinced that such a microcomputer represented the best solution to their problem, and the Altair 8800 was not a commercial piece of equipment by any criteria. Since the only other choice they had was a much more expensive minicomputer, with an even longer delivery time, they decided to build a copy of the Altair. Having made the decision to build their own 8080 computer, IMS Associates decided to correct the obvious defects of the Altair and build a rugged commercial grade machine.

The most glaring defect of the Altair was the location of the expansion motherboards. MITS used a standard Optima case to house the computer, and its shape dictated the mounting position of the motherboards. This in turn caused the board mounting connectors to face the side of the cabinet. As a result, the connections from the front panel to the motherboard required a large cable. In addition to making the computer kit harder to build, this cable was a potential source of trouble over the life of the computer. IMS Associates designed their own cabinet and made it much deeper than wide. This allowed the Imsai to be made with the motherboard perpendicular to the front panel so that the front panel itself could be plugged into the first connector on the motherboard. This eliminated the large connecting cable.

The front panel of the Altair used small toggle switches to program the computer in binary machine language (ones and zeros were represented by switches "on" or "off".) The Imsai used the same arrangement but replaced the Altair's toggle switches with heavy commercial-grade "paddle" switches. The plastic switch "paddles" were colored red or blue. Mounted above the paddle switches was a colorful plastic panel with the indicator lights showing through. The name *IMSAI 8080* was displayed in the upper right-hand corner of the panel. To emphasize that this indeed was a commercial-grade computer, the heavy aluminum cover was painted what was then called "IBM Blue." In all, the Imsai design was very impressive and professional.

Once the Imsai cover was removed, you could see that the obvious and most impressive difference between the Altair and the Imsai was the power supply. The Altair used a power



The Imsai 8080

supply rated at 8-amps and constructed of radio grade components. This was thought to be more than adequate for the original design of the computer, but not for an expanded system. (MITS later had to upgrade the power supply to allow for growth.) The Imsai power supply, on the other hand,

came equipped with a massive transformer and very large computer-grade capacitors. The standard model was rated at 20 amps, and for a small upgrade fee you could get a huge 30-amp supply. This big power supply could deliver 30 amps at 5 volts and 3 amps at + - 16 volts. Having a large power supply was an advantage because all the S-100 Bus computers used un-regulated power supplies with power regulators located on each individual circuit board. One of the most common causes of failure in S-100 computers was failure of the on-board power regulators. The use of massive transformers and capacitors provided less electrical fluctuation and longer life for the power regulators. In addition, larger power supplies provide a reserve for later expansion.

For the computer owner, selection of motherboards for the Imsai was very important. The standard kit or assembled unit only came with a 6-slot motherboard (2 more than the Altair), but only two connectors. To expand the system, additional connectors and 4-slot motherboards had to be added to the computer. Every time you added a connector, you had to carefully solder 100 connector pins to the board. Whenever a motherboard section was added, 100 wires had to be added. This required making 200 solder connections, and every solder connection was a potential source of trouble. The Altair connectors were made with a different pin spacing than the standard 0.125-inch Texas Instruments connectors used by Imsai. You could plug the same circuit board into either type of connector, but the pins that went into the motherboard were spaced differently. The Imsai connectors cost from $7 to $10 while the Altair connectors cost $15 each and were harder to get.

Imsai offered a 22-slot motherboard as a $52 option, when you ordered it with the computer. This was the solution to the motherboard problem. If you installed with at least 10 connectors, additional soldering seldom had to be done. Word got around very fast, and almost everybody ordered the Imsai with 22-slot motherboards and 10 connectors.

Like the Altair, the Imsai kit only came with the front panel board and the CPU board. No memory or input/output board was provided. However, by the time the Imsai was being shipped, there were several choices of memory boards

available. Imsai made an excellent 4K Static RAM board for $139 in kit form. Processor Technology had both 4K and 8K Static Ram boards available, and even MITS had 8K Ram boards and a new 4K Ram board that worked.

You really needed about 16K of memory to load BASIC and generate programs with usable data. You also had to have a working Input/Output (I/O) board to get things in or out of the computer. I/O boards came in either serial or parallel form, or both. One of the most popular I/O boards was the 3P+S from Processor Technology, which had both forms of I/O on one board. Imsai advertised that they were developing a super I/O board called the Multiple I/O (MIO) Board, but it never seemed to come out and was referred to as the "Missing I/O Board."

One most important thing that MITS had over Imsai was the BASIC written by Bill Gates of Microsoft, which was very important because lack of a good BASIC made operation very difficult.

Imsai had little software capability. The only software they supplied Imsai was a modified version of the Software #1 package, written for Processor Technology and placed in the public domain. This was delivered on a paper tape and required 8K of memory. The software consisted of a executive program, including a text editor and an assembler program for assembly language. To use it, you had to have a teletype tape reader. The procedure was not simple. First, you used the computer's front panel switches to load in a bootstrap loader program, one byte at a time.

Once the loader was in memory, you could start the tape reader and load the executive program from the tape. Now, you could use the keyboard on the teletype to write an assembly program, and the executive program could assemble it. If that worked, the result was object code for your program, and it could be stored in RAM memory. If you had enough memory, you could run your program. Then if everything ran okay, you could store your program using the punch on the teletype to make a new paper tape. The next time you wanted to run the program, all you had to do was load the object code paper tape back into memory and there you were. Simple! This was not exactly what we today call

"user friendly," and this is why having a higher level language like BASIC was so important.

Imsai advertised both 4K and 8K BASIC but noted that this was under development and would be available "real soon now." Imsai owners did not wait; they got Altair (Microsoft) BASIC by hook or by crook (mostly by buying it as a group and sharing it among themselves.) Altair BASIC soon became the standard language for personal computers even before Microsoft got out of its restrictive agreement with Altair.

In spite of its usefulness, the Teletype® as an I/O device, printer, and mass storage device was too expensive, too hard to get, and too hard to use. The audio cassette interface was a much better choice. Tape recorders were low in cost and easy to use. The problem was that there was no standard interface, and tapes made with one interface could not be read by another. The industry held a meeting in Kansas City to develop a cassette tape standard, but few adhered to it. Finally, because it worked the best, the Tarbell Cassette Interface became a *de facto* standard for S-100 computers, except for notable exceptions like MITS and Processor Technology's SOL. Cassette tape took over I/O functions from the paper tape punch and reader until floppy disks became commonplace. Video terminals and low cost printers also became available for microcomputers.

IBM had developed the floppy disk to load software, and Altair, Imsai, and other companies were working to adapt it for use on microcomputers. The development of floppy disks and disk operating systems, plus cheap RAM memory, opened up the industry for really useful software, and completed the transition from hobbyist's toys to really useful computer systems.

Because of component board interchangeability, almost no one ran a complete Imsai Computer System. The computer itself might be an Imsai with its 8080 CPU, but even that was likely to be a Z80 CPU from TDL, or Cromemco. The memory could come from any of two dozen manufacturers. Seals Memory were popular 8K boards as were Vector Graphic, IMS (not related to Imsai), and Processor Technology. In 16K memory boards, Cromemco and Processor Technology were well thought of, as were TDL, Seals, IMS,

The 8-inch floppy disk was the mainstay of serious personal computing storage in the late 1970s. This Imsai peripheral unit provided two such drives. Today, *one* 3.5-inch or 5.25-inch diskette can hold more information than four 8-inch disks.

and a few others. The I/O board was most likely to be a 3P+S from Processor Technology although George Morrow made a popular one and some people liked the Vector Graphic. The computer terminal was likely to be a Adam 3A or a Hazeltine 1500. Many users saved money, and in place of a separate video terminal, installed a Processor Technology Video Display Module (VDM) and a keyboard. With this combination, they used the computer itself as a terminal.

For data and program storage, they often used the Tarbell Cassette Interface before the advent of the floppy disk drive. Imsai's first attempt at a "smart" floppy disk drive was a total failure. Later, various disk drives from MITS, Pertec Persi, North Star, George Morrow, Micromation, and Cromemco were installed in Imsai computers. Imsai finally did manage to come out with its own working floppy disk unit. At first, all the floppy disks were 8-inch units and were very expensive. When the 5 ¼-inch floppy disk drives came out, many computer owners who had not been able to afford disk drives

Documentation was everything in those days of limited technical support.

purchased them from Pertec, North Star, and other companies.

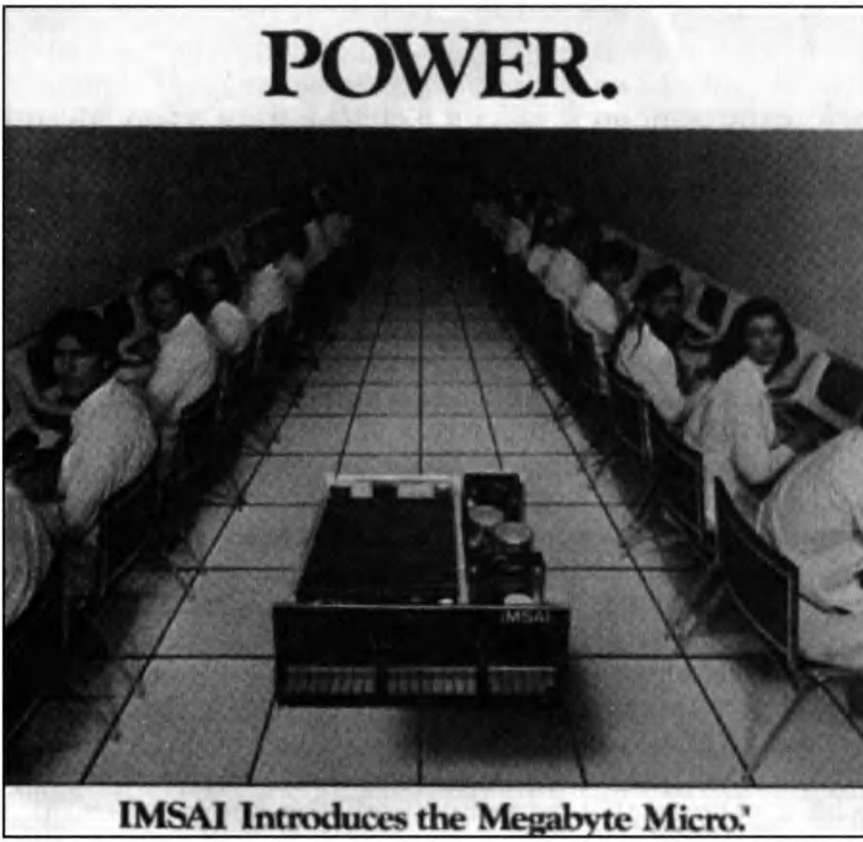
One very important thing that Imsai did to advance the use of floppy disks was to license the best disk operating system, later to be known as CP/M. In fact, it was money from the Imsai license that encouraged Gary Killdal to form Digital Research Incorporated and to get into the CP/M operating system business.

While Imsai never became a successful systems house as did Cromemco and others, the Imsai 8080 with its massive power supply and 22-slot chassis was a foundation for almost any 8080 or Z-80 system you could think of. Even Alpha Micro Systems used the Imsai for its first 16-bit multi-user systems.

From IMS Associates To IMSAI Incorporated

The company that developed the Imsai was very different from the company which invented the MITS Altair. Ed Roberts of MITS was a technical person who was propelled into the leadership of a rapidly expanding computer company. Bill Millard, on the other hand, was an entrepreneur

who envisioned the growth of his company into a vast computer utility. He was a believer in the self-improvement techniques developed by Werner Erhard, called "EST," which he attempted to apply to all situations. EST convinced him that once he had made up his mind to do something it was as good as done. He surrounded himself with people who had "taken the training," and this was a big factor in the accomplishment of bringing the Imsai to market in record time. It was also a factor in the failure to test equipment before releasing it to the market, and the inability to see changes in the market as the technology advanced. Fortunately for Imsai, in addition to Millard and his "estheads" the company also had



In 1977, Imsai was advertising its "Megabyte Micro," which was really a dream. It would be almost another 10 years before the IBM PC/AT could routinely match that amount of working memory.

the services of some of the best sales and marketing executives in the industry, including Ed Faber, who built both Imsai and Computerland, and Seymour Rubenstein, who founded MicroPro the owner of WordStar software.

It was said that MITS was a engineering company who did not know how to build and market their products. Imsai, on the other hand, was a marketing company who developed one brilliant product and overexploited it. From the Imsai 8080 on, they never knew the difference between a prototype and a production model, and never really had another successful computer.

The Life and Death of Imsai

When the Imsai 8080 was in development at IMS Associates, it looked like the company would run out of money before the computer was completed. As a last resort, Millard placed an ad in *Popular Electronics Magazine,* describing the computer and offering it for sale as a kit. The ploy worked beyond their wildest dreams. The computer hunger, fed by the Altair articles and the inability of MITS to deliver, impelled people to send in checks for the Imsai 8080 merely from the description in the small ads. Millard used some of the money to prepare a professional ad campaign and place ads in *Byte* and all the other computer magazines now appearing. The stream of checks grew to a flood and people started to inquire about becoming dealers.

As owner of the Computer Mart of New York, which was about to open, I was one of the first people to contact IMS Associates. They were very interested in selling in volume to dealers, but they had priced the kits at $439, a price too low to provide for dealer discounts. Quickly they raised the price to $499 and allowed a discount of only 20% for orders of 10 or more computers. This was still not enough margin to allow a dealer to make a profit after paying his overhead, considering the small quantity we could sell. Then Ed Faber came up with a scheme that benefited both the company and the dealers. He proposed that if we dealers could pay for the computers in advance, we could get another 5% and IMS would pay the shipping cost. For me that was the clincher; I sent off my check and prayed that IMS Associates would make

The computer that put Imsai out of business. For every one they sold, two would come back.

delivery on time. Little did I know that I would get priority because Millard and Faber wanted their computers on sale in New York where they were trying to raise capital.

Back in San Leandro, the people in IMS Associates went to work to build their first 50 kits to make the initial shipments. By December 1975, they had shipped the first lot and were at work on the second batch of 250 kits. Ten of these were mine, and never had I sweated out anything more than the arrival of those computers. I had exactly one complete computer, one partial kit for the Sphere computer, ten video monitors, one teletype, a lot of books, assorted parts, chips, and connectors to open a computer store with. We hoped to open March 1, 1976, but in the middle of January five of my Imsais arrived and we couldn't wait to open. Not convinced that we would ever make it, I had been looking for work and had contracted to write a manual for the Warner Communications Timesharing Service. We actually opened on New York's Fifth Avenue in back of Polk's Hobby Department Store in February 1976 and started immediately selling Imsais.

Ed Faber quickly saw the potential of the computer stores

and took IMS Associates (now called Imsai) out of the direct sales business. Instead, he developed a plan where a dealer had to commit to only 25 computers a year and put up a deposit of $2,500. The discount was put at 25%, and Imsai would ship on a C.O.D. basis rather than requiring cash in advance. For us established dealers, it was a great help. However, under this plan dealers sprouted all over the place, in garages, lofts, and hardware stores. In addition, the mail order discount dealers appeared, and people started to bring in kits they had bought by mail but couldn't put together.

At the first big computer show held in Atlantic City, New Jersey, on the weekend of August 27, 1976, Imsai was not an exhibitor–although MITS and every other company was showing their products–but Ed Faber walked through the show like a king. The truth was that there were more Imsai computers than any other make. Every retailer had Imsais, as well as people selling boards and peripherals. In addition there were heaps of Imsais piled up and marked with bargain prices for sale at the show. Although MITS was the biggest exhibitor at the show and introduced the new Altair B model, Imsai got the greatest attention

However, I was one of the few dealers not showing Imsai computers. Instead I had a brand new computer made on a single board. It did not need a teletype because it had its own video output to a TV set. It had a very fast cassette interface for data storage, and it had its own version of BASIC that came with the computer. It was called The Apple and it was being shown in my booth by two young men from California, Steve Jobs and Steve Wozniak. The Apple proved to be one of the hits of the show. In addition to the Apple, the show introduced the new Processor Technology SOL, the new Cromemco, and the TDL Z-80 CPU board for the S-100 Bus.

Although we did not realize it at this show, the handwriting was on the wall for the Imsai 8080 as well as the Altair. The new generation of computers was already here, and within a year the SOL became my biggest seller, followed by the Apple II a year later.

Imsai as a company tried to introduce several new products as an upgrade to the 8080. One was the "smart disk drive" mentioned previously. It was a single sided 8-inch floppy disk

drive originally set for introduction in 1976. The unit was released and shipped before it was completely tested, and it proved to have all kinds of design problems. When it did work for any length of time, it grew very hot and generated heat to distort the diskettes. It quickly became known as "The Imsai Pizza Oven" and was quickly withdrawn from the market. The next version took over a year to complete, although it was offered in the Imsai catalog.

Another product launched with an intensive advertising campaign was the Imsai 8048 Control Computer. This was a single board computer designed to control all kinds of electrical devices. The 8048 computer worked, but priced at $200 to $400 it found no market. Other devices such as the Commodore KIM-1 were much more versatile and cost only half as much.

In addition to the declining market for Imsai 8080 computers, and the lack of follow-on products, there were other problems in the Imsai Corporation. Bill Millard had decided that his future was to be in selling computers rather than manufacturing them. A man named John Martin had brought him the idea of setting up a franchise computer business to be called Computer Shack. Martin had actually copied the idea from Paul Terrell's Byte Shops, but had added some ideas from his experience in the franchise muffler business. Millard incorporated The Computer Shack franchise business, put Ed Faber in charge, and started to sell franchises.

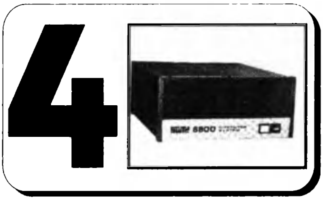
The new business caught the crest of the wave of interest in computer stores and quickly became a major force in the industry. The only setback was caused by Radio Shack, which caused a name change to Computerland. The Computerland stores carried Imsai computers but they also sold Apple, North Star, and Cromemco. In fact, the Imsai 8080 became one of the less popular computers in the stores.

Determined to dominate both the retail franchise and manufacturing ends of the computer business, Millard forced his Imsai division to produce a desk top business computer called the VDP-80. This was an all-in-one machine with the video monitor, keyboard, disk drives, and computer, all in one cabinet. Millard had the cabinet built in Europe with an eye to exterior design and no consideration given to the

requirements for the internal components. The new machine was plagued with problems and in addition had an unproven dual floppy disk drive made by Persci. This drive was almost impossible to keep in alignment under the most favorable conditions. In the furnace inside the VDP-80, it refused to run properly. Although intensive advertising sold this computer, Imsai could not afford to keep up their warranty. There was a quick re-design installing 5 ¼-inch drives to replace the 8-inch Persci drives and changing the name to VDP-40. However, the damage had been done. The Computer Mart of New York refused to sell the VDP-80 and gave up the Imsai dealership, which had become unimportant anyway.

Millard had stripped Imsai of all its resources and put them into Computerland. Bankruptcy quickly followed for Imsai. While Computerland went on to become the most important retailer of Apple and IBM PCs, the foundation crumbled and Imsai disappeared. Many of the assets of Imsai, including the rights to the name, were bought by Fisher-Fitas, a former subcontractor to Imsai. They continued the manufacture of the original rugged 8080 machines until the parts ran out and then the Imsai 8080 became history.

Computerland stores prospered as the primary retailer of IBM computers but, when IBM abandoned the ISA bus and the clone business started, they fell on hard times. The franchisers joined in a bitter legal battle with Millard and became independent of his control.



SOUTH WEST TECHNICAL PRODUCTS' M6800, THE FRIENDLY COMPUTER

South West Technical Products (SWTPC) was the most unusual of the early personal computer companies. First, it lasted the longest of all the pioneers, and second, it existed before the start of the personal computer age and contributed as much as MITS or Imsai in establishing it. In addition, it was always owned by one man, Dan Meyer, whose personality and ideas determined the products it made and the way it did business. STWPC was also unique in that it made a complete line of computers, peripherals, and software, and made most of the parts in its own factory.

South West established its own unique bus architecture, the SS-50 Bus, which came to be used by several other manufacturers. In spite of this, it's a safe bet that most of my readers have never heard of South West Technical Products.

One day, a tall young man came into the store and asked, "Do you have any SWITS?"

Kelvin Smith, my manager, not knowing what was meant more than half the time when the computer nuts asked something, repeated, "Stan, got any Swits?"

So I came out of the back room and asked the kid, "What's Swits?"

"I mean South West Technical Products M6800 Computers, SWITS!" he replied.

"Well, no, but I have Sphere 6800 computers."

"Junk," the kid answered. "How can you call this a computer store if you don't have South West?"

"Go on. Beat it," I snarled. I was tired of being told off because I didn't have everything advertised in *Byte*!

He left.

Sometime later, I went to a meeting of the Amateur Computer Club of New Jersey, and a 14-year old named Tod Loofbrourrow showed a computer he had built. It was a small black box with no front panel, and it looked a little like an audio power amplifier.

I was finally seeing a "Swits!"

The demo was astounding. The computer worked, ran software, and powered a teletype. I was impressed. When I returned to New York, I spoke with Leslie Solomon, Technical Director of *Popular Electronics Magazine,* about it.

"Sure, SWTPC is one of our oldest kit makers, and Dan Meyer the owner is a great guy. You ought to sell his computers."

So I called South West in San Antonio, Texas.

"Mr. Meyer," I said, "I'd like to sell your computer line in my computer store."

"No," Dan replied. "I sell them myself, by mail. I don't sell through stores."

"Well," I answered, "computers are something new. It's not like your audio equipment. People want to see how they work before they buy them. Les Solomon says I should sell 'em."

"Les says that? Okay, I'll give you 25% discount and ship you ten computers as a trial. You'll get five this week and five next week. You pay me in 30 days or we're finished."

My God, he was offering me 30-day credit! Nobody else in the industry gave *any* credit–they even wanted pre-payment!

The five computer kits arrived on time, and I took one home and built it. It was so easy even I could build it, and I was a slob with a soldering iron.

A week later, the tall kid was back. "Heard you got SWITS.

Now you're cooking. Would you like me to bring in my video terminal?"

"What video terminal?" I asked.

"South West makes it–goes with the computer instead of the Teletype®."

"Sure," I answered. "Bring it in. By the way, what is your name?"

"Ken Stamm," he told me. "See you tomorrow."

The next day he returned, bringing with him a strange wooden box with a keyboard sticking out of the front and a lot of wires out of the back. In a few minutes Ken had it hooked to my computer and one of the video monitors in the store. He turned on everything and started typing on the keyboard. Wonder of wonders, the characters he typed

SWPTC had nice prices, as is shown in this 1977 ad. If you were willing to forego the $995 floppy disks peripheral (using the AC-30 cassette interface instead) and had an old surplus terminal, you could have a computer with 4K of memory for less than $500. Of course, you still had to build it from the kit the component parts came in.

started appearing on the video screen. It worked! Soon he was running programs on the 6800 computer. This kid knew something!

"How would you like working here after school?" I asked him.

"Okay," he said. "I'd like that."

The next day, he appeared with more things he said I needed for the 6800. Soon, Ken was on the phone with South West ordering all kinds of things for us to sell. He worked for us as long as the Computer Mart of New York was in business and became our expert on SWTPC. In fact, he just about ran that portion of the business.

Dan Meyer founded SWTPC in San Antonio, Texas as an electronics company devoted to building low-cost electronic kits, many of which were originally projects in magazines such as *Popular Electronics* and *Radio Electronics.* Some of their products, like the 250-watt "Tigersaurus" Amplifier, enabled hobbyists who were skilled with the soldering iron to have a high-powered audio amplifier for only $154.00. South West also made the Tiger 60 watt amp and a Pre-Amp for it. Other products, such as a Guitar Pre-Amp, Input Mixer, and Stereo Octave Equalizer, rounded out the audio kit line. Then there was the Theremin Electronic Musical Instrument, which was played by moving your hands, and the Psychedelia Color Organs. These, and other products developed as kits from magazine articles, put SWTPC on the leading edge of electronic experimentation.

The unusual thing about these kits was that they were priced low so that the hobbyist could afford them, yet they were engineered so they worked well when they were assembled. Dan Meyer carried these principles over to the personal computer business, which was one of the reasons for the long survival of his company. No one was ever mad at SWTPC after completing their computer assembly. Nine out of ten computers worked the first time when the power was switched on.

The first digital product SWTPC built was a Digital Logic Microlab, which enabled an experimenter to learn about digital logic with the aid of Don Lancaster's *RTL Cookbook.* The second computer product was the KBD-2 Keyboard and

South West Technical Products Corporation had the advantage of already being a successful manufacturer and marketer of audio kits. This ultramodern building in Austin, Texas was corporate headquarters.

Encoder Kit. This was a fully ASCII-encoded 53-key system with standard digital logic output. It was ready to connect into any video terminal, including a product like Don Lancaster's TV Typewriter, which had appeared in *Radio Electronics* magazine. The amazing thing about this keyboard was its price of $39.95, a true bargain at a time when surplus keyboards cost twice as much. The kit did not make the highest quality keyboard. Its key switches occasionally went bad, leaving you without a character, but it was cheap and easy to fix.

Before South West built a computer, they made an affordable terminal kit for the many hobbyists and students who were beginning to access college computer networks. The CT-1024 Terminal Kit was capable of displaying 32 upper-case, alpha-numeric characters on a video monitor or a modified TV set. It could not communicate with IBM equipment, which used the EBCDIC code system, or with the old 5-level Baudot-coded Teletypes® (which were often in use in those days because hobbyists could buy them very cheaply.)

The CT-1024 terminal had a memory composed of six 2102 static RAM chips, which could store 1024 (1K) characters. The unit did not have scrolling, and was only capable of

displaying 512 characters at one time on the screen (this was called "a page.") You could then flip a switch and display the second page of 512 characters. When it got to the last character position, of the last line, the cursor would return to the first character position of the first line.

The CT-1024 Terminal had quite a few optional boards which extended its capabilities. A Computer Controlled Cursor option was available as a kit. This allowed computer control over the position of the cursor on the screen. Input or output (I/O) for the terminal was provided by adding another kit of parts. You could put together either a serial I/O option or a parallel I/O option. The builder was warned that while the serial option was in accordance with the usual standard for connection, RS-232C, there was no equivalent standard for parallel interface, and therefore it might be difficult to make the interface work. SWTPC recommended that you use the serial kit.

Another option was the Screen Read Board. This gadget was used when information that had been typed into the terminal was edited, and had to be read out of the terminal and into another device. This was not needed with a computer in the interactive mode.

SWTPC would sell you the basic video terminal kit for only $175 without the keyboard, power supply, interface, or cursor control. The complete CT-1024 terminal kit was $275, with only the baud rate kit at $14.75 and the parallel omitted.

The Altair computer was introduced to the world in the January 1975 issue of *Popular Electronics* magazine, and the personal computer revolution started. However, the Intel 8080 CPU upon which the Altair, and later the IMSAI, were based was not the only microprocessor. Motorola had developed the M 6800 MPU (Micro Processor Unit) which was somewhat different from the Intel design. The 6800 MPU was part of a family of chips that made computer design, and use, quite a bit easier.

SWTPC used these chips to design a computer that was simpler to build and program than the Altair design, and cost much less to manufacture. In addition, since SWTPC was an established company, it had the facilities to build the machines, and the organization to meet its delivery dates.

When you first looked at the SWTPC 6800 Computer System, you noticed it was completely unlike the Altair or IMSAI computers. All you saw was a black and silver box with a cover made of black grillwork and two illuminated push buttons on the front. It might have been an audio amplifier, except that it said "SWTPC 6800 Computer System" in large black letters. There were no red and green lights, or rows of switches to set. How did you operate this computer? The secret was in a ROM chip which contained a monitor program called MIKBUG. When you turned on the system, it came to life and permitted your computer to communicate with a terminal. MIKBUG was also a mini-operating system that allowed you to display and change data in memory, dump memory to tape, load a program, display or change the contents of registers, and jump to and execute a program in memory. It also had a routine for debugging programs. All of these system functions were initiated and monitored by a serial terminal. In addition to these system features, MIKBUG understood Hex notation instead of machine code needed for programming front panel switches on other computers.

Contrast this with the Altair. To make the Altair talk to a terminal you had to go through the long process to load a bootstrap loader program. If everything went well, you could be up and running within 15 or 20 minutes. This was one more reason the Motorola system was so popular. It made the SWTPC 6800 such an easy-to-use computer that its owners seldom ever had any complaints to talk about. Boring, boring, when the hobbyists got together at the computer club to discuss their problems; the SWTPC 6800 owner just sat and had no problems to contribute. Dan Meyer made this situation a feature of his advertising after a user wrote in about it.

We sold a lot of these computer kits to customers all over the world. People would come to New York and head for our store because they had heard that we sold SWTPC products, and we had employees who spoke many languages.

Building The SWTPC 6800 Computer

The 6800 had very few parts for a computer. Eliminating the front panel board used with the Altair design was a big

help, but the integrated 6800 chip family also required fewer support chips. The 9 by 14-inch motherboard came with all the sockets you would ever need, and they were very different from the Altair (S-100) design which used card-edge sockets and very thin plated lands on the boards. The SWTPC design used Molex® connectors that were long metal pins that stuck up through the motherboard. The circuit cards had sockets which fit over the pins, providing a positive contact. SWTPC provided all the pins for each motherboard. The motherboard held seven 50-pin sockets for processor and memory boards, and eight sockets for the smaller interface boards. You could parallel another motherboard if you ever needed additional slots. The power supply was large enough to support the full compliment of plug-in cards, which originally was one PM board, 4K of static RAM, plus eight interface cards. The design of the motherboard made it simple to build, and although it was tiresome to solder in all of the socket pins, it did not require the close work needed to install S-100 sockets, which had twice as many pins per socket.

The MP-A Microprocessor/System Board (MP-A Board) was the primary logic board used in the system. It contained the 6800 CPU, the 6830 ROM, and the 6810 Scratch Pad Memory (128-bytes) for the ROM. The MP-A also mounted the crystal-controlled processor clock driver and baud rate generator, plus reset and other circuits. The beauty of the SWTPC design was that the lands on the cards were very, very broad compared to S-100 cards. This made it much easier to solder them, and prevented the dreaded solder bridges.

The original memory capacity of the SWTPC 6800 was a huge 16K of RAM. Each MP-M memory board had a capacity of 4K, but when you bought the computer system you got the board with 2K of RAM chips. You could buy the extra memory chips to fill the board, and you could buy extra memory boards. The memory board with 2K was $85 and the additional RAM was $45. Four memory boards fit into the motherboard for the total of 16K. Of course later, when 4K chips became available, you could expand the memory, since, like all 8-bit CPUs, the 6800 was capable of addressing 64K of memory. However, the 2K of static 2102 RAM

THINKING ABOUT A "6800" TYPE COMPUTER?

It seems that a great many people came to the same conclusion that we did here at SwTPC. The M6800 is an outstanding processor and makes a great computer – "BUT" – Not all computers using the M6800 processor are the same. May we suggest that you consider the following features when you make your choice.

IT IS A COMPLETE 6800 SYSTEM?

You cannot get all of the advantages of the 6800 system with only the processor chip. Unless the whole 6800 family of chips is used you cannot possibly get all of the versitility and superior performance that the system is capable of providing. If for instance the design does not use the MC6820 parallel and the MC6850 serial integrated circuits for interfacing, you lose the programmable interface feature that makes it so easy to interconnect the computer system with outside devices such as terminals, printers, disks, etc.

IS THE SOFTWARE COMPATABLE OR UNIQUE?

If the design does not use the "Motorola" Mikbug® ROM, then the software and programs that will run on the system are probably unique to that particular brand of computer. SwTPC uses the standard Motorola MCM6830L7 ROM. This provides automatic loading and an operating system that is compatable with other systems using the standard widely sold Motorola evaluation set. As an owner of our 6800 computer system, you are eligible for membership in the Motorola Users Group. If you join you have access to a library of programs that will run on your system. Editor and assembler programs are available directly from SwTPC.

CAN THE SYSTEM BE EXPANDED AT A REASONABLE COST?

Some of the limited systems being offered at lower prices can be expanded only with difficulty. Check the amount of memory that can be added and at what cost. How many additional interfaces can be added, if any. How much of the above can be run off of the power supply provided with the system? The SwTPC 6800 can be expanded up to 16K words of memory in the standard cabinet and with the power supply provided. It may also be expanded up to eight interface (I/O) boards for external devices by simply plugging in the cards. Memory is $125.00 for each 4,096 words of expansion and interface cards are only $35.00 for serial or parallel types.

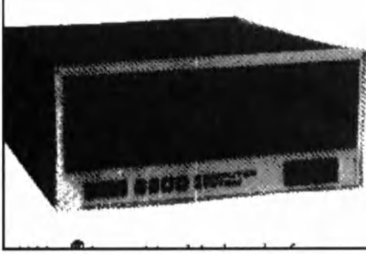
Memory expansion will be essential if you ever intend to use a resident assembler, or higher level languages such as APL or BASIC on your system. Assembler programs typically require a minimum of 4,096 words of memory and higher level languages require even more.

HOW DO YOU ENTER AND READ DATA?

Let's hope it is by way of a TTY, or video terminal. No one with a serious computer application would consider attempting to enter data from a switch and status light console. These may be educational, but they sure aren't practical. Calculator keypads and digital readouts are not much better. There is no substitute for a full alphanumeric keyboard and terminal system display for serious work.

Mikbug® is a registered trademark of Motorola Inc.

SwTPC 6800
Computer System
with serial interface and 2,048 words of memory $395.00



THE COMPUTER MART OF N.Y.
314 Fifth Avenue
N.Y.C., N.Y. 10001
(212) - 279 - 1048

THE COMPUTER MART OF L.I.
2072 Front Street
East Meadow, N.Y. 11554
(516) - 794 - 0510

We included this SWPTC ad in our catalog at The Computer Mart.

consumed 0.75 amps of power! By this same scale of measurement, if we used the same kind of chips today, 640K of RAM would draw 240 amps of power at 5 volts DC, thus consuming

1200 watts of power. You would need a separate power line to run the computer, and you could not also run the stove in an average house.

At first glance, the SWTPC 6800 system did not look much cheaper than the Altair or IMSAI—they all cost about $475—but with the 8080-based computers all you got for that price was a barebones computer. No memory, no I/0, and no software. You only got four slots, and even they didn't have all the required connectors. Your $450 was only a down payment on a very expensive computer. With the SWTPC 6800 computer you got all the connectors, an operating system in ROM, and a memory board with 2K of RAM for $395. The extra 2K of RAM was only $45, and the I/0 board was $35. For $475, SWTPC sold you a kit for a complete operating computer. Of course, you could add to it, but your total final cost was nowhere near the price of an S-100 system.

Software for the SWTPC 6800

From the beginning, Dan Meyer and Gary Kay, his engineer/designer, recognized that the secret to the success of their computer lay in software. Having the operating system in ROM was a break for them, but more software was essential. Fortunately, there was an Assembler program available for the 6800 that could be adopted for their computer. SWTPC made it available to owners for $14.95, in either paper tape for Teletype®, or audio cassette format. This low pricing set the pattern for all SWTPC software. While MITS was charging $150 for BASIC, Dan Meyer set the price by the "K," 4K BASIC cost $4, 8K BASIC was $8 and 12K BASIC was $12! Although the SWTPC 6800 did not have Altair BASIC, they had a version written by Robert Uiterwyk that was one of the best cassette BASICs on the market.

The AC-30 Cassette Interface

The greatest need for the early computers was a reliable method of mass storage. The paper tape of the Teletype® was only available to those who were lucky, or rich enough to have access to such a machine, and they were a painfully slow method of saving programs and data. At that time, "real"

A close-up of the SWTPC logo.

computers used digital tape drives that cost thousands of dollars, or the new disk system recently invented by IBM. Computer hobbyists, ever inventive, discovered that they could record the tones of a modem on an audio cassette and save them. When replayed, they would recreate the ones and zeros of a digital data stream, and from that beginning came the cassette data storage method. The only problem was that each manufacturer had a different recording method, and the tapes were not interchangeable. In November 1975, *Byte* magazine called a meeting in Kansas City to set a standard for the recording of digital data by audio cassettes. SWTPC attended and accepted the resulting Kansas City Standard of 300 baud data speed, with 2400Hz sine wave representing a logical one, and 1200Hz sine wave representing a logical zero. As a result, SWTPC built a cassette interface unit capable of supporting two cassette recorders and able to control the motors of both the cassette recorders. The unit was designated the AC-30 and sold in kit form for $79.50. While this unit was used with the 6800 computers it never became accepted by any other system because no other company used the "Standard." Both Apple and SOL computers had a cassette system that was reliable at 1200 baud.

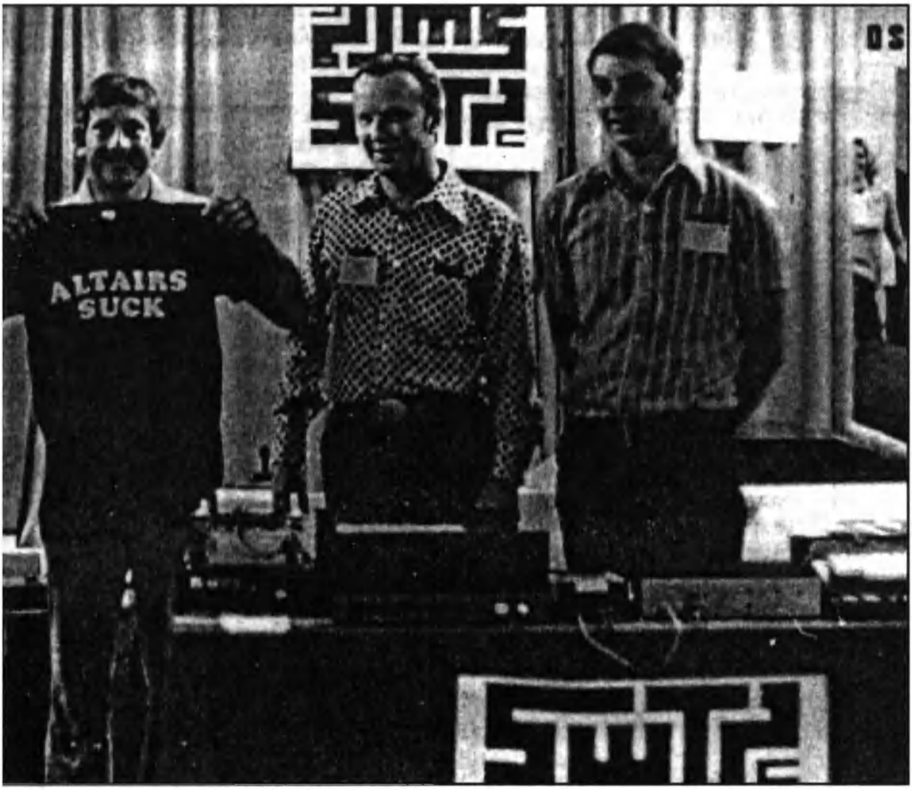
The PR-40 Printer

Low cost, high quality printers are the usual thing these days, but I remember when printers cost much more than computers. The Centronics 779 finally broke the $1,000 price barrier in 1977, and Epson was the first to offer a quality printer at $600.

Way back in 1976, SWTPC alone found a way to sell a really low-cost printer to hobbyists. Seiko made a print mechanism for cash registers that would print 40 columns and Dan Meyer obtained these printer mechanisms. His company incorporated them into a little printer that printed 5 x 7 dot matrix, upper case only, at a rate of 75 lines per minute. The print line was 40 characters wide on a roll of standard adding machine paper, but it was enough for listing programs or short notes. Such a machine would attract scant notice today, but in those days a printer for $250 was a great bargain. The PR-40 was sold as a kit although the print mechanism was completely assembled. The electronics had to be constructed, and the entire assembly mounted upon one of SWTPC's metal chassis.

This completed the full starting lineup for SWTPC, and they advertised widely that here was a computer system that almost anyone could build. I say *almost* because we did have some people who ruined their kits. One of them glued all the parts to the board and brought the mess in to be wired so it worked. Another burnt the motherboard by using a torch for soldering. One accountant had such trouble that he kept coming into my store. We became friends, and he eventually became my partner. Needless to say, from then on he kept the books, and my technicians built his computers.

At the big computer show in Atlantic City, New Jersey in the summer of 1976, Dan Meyer and his entire crew came to the Shelborne Hotel to show off their computer system. Dan was very proud of his complete line. He and all of the SWTPC crew wore tee-shirts emblazoned with "Altairs Suck" on the front. This was a little too much for the show management, who did not want to offend their largest exhibitor. Meyer was requested to remove the shirts. However, he had already



The legendary "Altairs Suck" tee-shirt from the 1976 Personal Computing Convention in Atlantic City. From left to right are Bill Thames, Ted Uiterwyk, Robert Uiterwyk (author of Microbasic and 4k Basic), Gary Kay, Dan Meyer (president of SWPTC), and Joe Deres. The photograph was taken by Jim Stratigos of the Atlanta Area Microcomputer Hobbyist Club, who was helping out at the convention.

made his point, and he got a lot of attention.

After the show, the SWTPC 6800 continued to do very well; however, things were changing in the industry. Floppy disks were rapidly replacing cassettes as storage devices. At first, when the 8-inch floppies came out, they were too expensive for the price range of the SWTPC customers, although other companies sold them to use with 6800 computers. However, when the 5 ¼-inch floppies became popular, South West immediately designed a system to go with

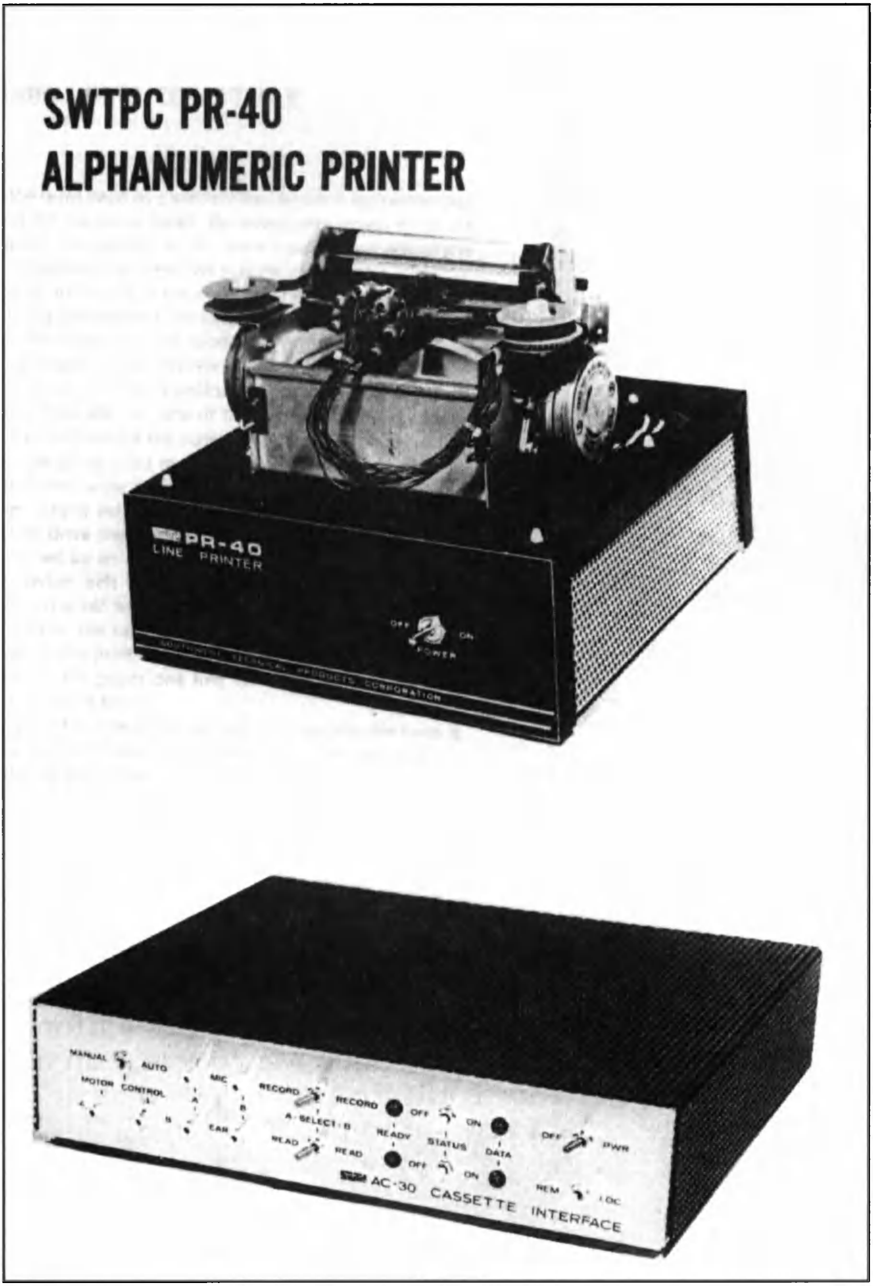
their machines. This started problems that Dan Meyer never expected.

SWTPC had no problems with software until the first floppy disks were ready to be connected to the 6800 computers. Bob Uiterwyk, who had written SWTPC BASIC, had promised to produce an operating system and actually produced a system called FDOS. There were problems with this system because it only supported sequential files and not random files. To those not familiar with disk files, I must explain that this deficiency meant that FDOS was nothing more than a cassette system used on a disk. You see, a cassette stores programs and data sequentially, like a row of ducks, and you have to search through the entire tape to find what you are looking for.

The normal disk operating system, with its random file system, rapidly locates data anywhere on the disk. This is the major advantage of disks over tapes, and without it the speed advantage of disks does not exist. Well, the lack of such a system hurt the sales of SWTPC systems just at a time when floppy disks were replacing cassettes all over the industry. Finally, Dan Meyer and his staff wrote a specification for a real DOS, and it was implemented by TSC under the name of FLEX. This single-user system became quite popular and later was expanded to multi-user operation under the name UNIFLEX. Another DOS often used with 6800 systems is OS/9, which will also run on SWTPC machines with the 6809 CPU.

The problem with the disk system also produced terrible strains in the dealer organization. When the system was selling well, Dan never shipped all the components we ordered. I don't know if this was because demand exceeded production or because he still sold equipment direct and the more computers the dealers sold, the greater the demand for add-ons, which often only he could supply. Our strategy was to order much more than we needed. SWTPC would cut our order, and we would end up with the quantity we actually needed. The slowdown in sales hit our store much later than it did others because a lot of our business came from overseas, but it did affect us.

Then I began to notice that we were receiving a lot of



SWPTC's PR-40 printer and AC-30 were inexpensive and reliable devices. Of course, it did take 15 minutes to load BASIC from tape, and one little glitch meant you had to start all over again.

packages from South West in our daily UPS shipments. I called Kenny in and asked him what was going on. Did he have a large foreign order to fill? He told me that he did not have any unfilled orders and that stuff was starting to fill the storage cabinets. Then I called San Antonio, and they told me that they were filling back-orders that had not previously been shipped! I quickly took an inventory and canceled all back orders we absolutely did not need. However, the damage had been done, and I owed Dan Meyer more money than I could pay him by the end of the month. I called and told him my problem. Dan was not very pleased.

"I told you had to pay me at the end of the month, and there would be no extensions," he tartly snarled at me.

"Okay, but I have a cash flow problem right now. My taxes are due, and if it comes to a choice between paying my taxes and paying you, it is an easy decision for me to make. I will pay what I can now and pay you the rest as soon as possible. Just don't send me any more stuff."

"Don't worry, I won't. But from now on you are on a C.O.D. basis."

"That's your decision," I told him. "You won't find it easy to replace our store in New York."

So three years of close friendship went down the drain.

Later, I met one of his other dealers at a computer show. "How are you getting along with Dan Meyer?' I asked him.

"Dan is mad at me," he replied. "He shipped me so much stuff I couldn't pay for it."

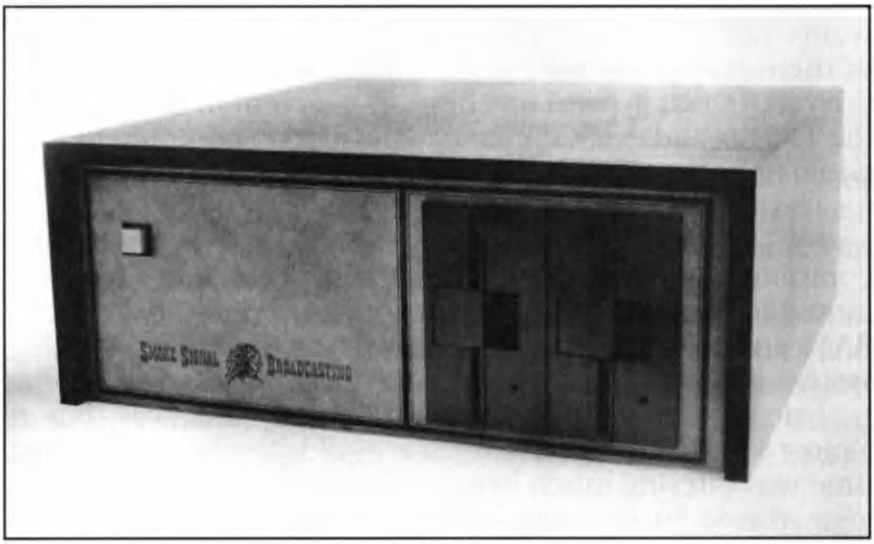
I told him of my experience, and when we talked to other dealers, it was the same story! The story we pieced together was probably true, although I cannot completely vouch for it.

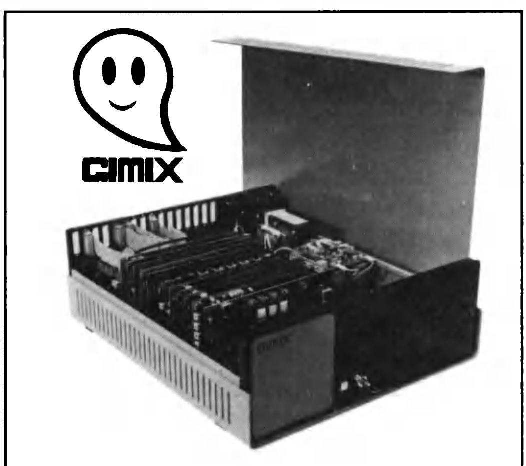
It seemed that what Dan had done was to repeat an old trick attributed to Henry Ford. He had a commitment to Shugart Associates for a large quantity of floppy disk drives, and they shipped them in every week. If he canceled the contract they would charge back the price of all his drives at the smaller quantity price. They might also sue him for violating his contract. He was not selling the drives and did not have the cash to meet his payments. So he scrapped together every part he could get and used them to fill all the dealer's unfilled back orders. He shipped them all over the

country and thus built up his accounts receivable, which he could borrow against to meet his obligations. The trouble came when the dealers could not pay all the bills on time.

I do not know what happened next, since, with my credit cut off and sales of SWTPC stuff declining, I sort of lost contact with Dan. We continued to sell the SWTPC 6800, but with the growth of Apple II our sales were at a minimum. We finally all but dropped the line as far as selling new computers went.

This may have had something to do with Dan's later





SWPTC influenced other companies to build computers and boards using the SS50 bus. The Smoke Signal Broadcasting Chieftain and the Gimix Ghost were two of the more successful.

decision to get out of what he called "hobby computers" and concentrate on "business machines."

SWTPC did improve its products. It introduced a new, improved 6809 CPU, and both a line of 8" floppy disk drives and 5 ¼" floppy disk drives. The powerful UNIFLEX operating system was introduced, and much-improved terminals: the CT-64 and the CT-82.

SWTPC had always been a kit company, and they never attempted to produce a factory-manufactured computer product. This was completely in tune with the hobbyist market that started this industry. However, only so many people want to actually build their own computer, and by 1978 most of them had already done so, and they were committed to their particular type of machine. The advent of the Apple II, the TRS-80, and the SOL changed the market completely. You could now buy a better computer than you could build, and for less money. The market for kits collapsed.

SWTPC then offered their System B, a completely built computer system with two floppy disk drives and a terminal mounted in a desk. The system cost $4,495 and had 40K of RAM, and 1.2Mbyte of disk storage. It ran the FLEX operating system, and came with BASIC and Assembler.

I do not know how successful this system was, but at almost $5,000 I doubt if many were sold. The industry at that time was offering much better value in CP/M systems. However, the SS-50 Bus was still very strong in the 6800/6809 field, and many special-purpose computer devices were sold for industrial purposes. Two other companies, GIMIX and Smoke Signal, built SS-50 bus machines, and they did very well for a long time.

SWTPC eventually withdrew completely from the "hobbyist" market, and only built business machines and special purpose computers that were used in point-of-sale systems and other commercial applications.

5

THE EARLY DAYS OF APPLE COMPUTER

We were just beginning to realize that the computer store might be a success beyond our dreams and that the little space in Polk's Hobby Store might not be enough, when I received a phone call.

It was a very fast-talking young man who told me, "I'm Steve Jobs." He said that he had been sent by Paul Terrell and John French, who had both bought his great single board computer and become dealers. Paul had bought 50 of them! This was the greatest thing since sliced bread, and he had to send me one.

"Sure, send it," I said. After all, Paul and John were friends and I would go with their choice. Whamo! Next day Fedex delivered a package C.O.D. $500.

I was a little taken aback, but I paid the charge and gave the package to Dave, one of my techs.

"Here. Look at this, and let me know what you think," I told him.

"What is it?" he answered.

"A computer, the Apple 1."

"Whaddya mean a computer? All in that little box? Commmon!"

He took the box and disappeared. Later, he took some money from the cash register and went to Radio Shack. When he came back, he fiddled with some wires and a video monitor, and called me over to see what he had done. A Radio

Shack transformer was wired to a plug that went into the wall. The other side had wires into the page-sized PC board. A black square appeared on the video screen.

"See! It works," Dave told me.

"What does it do?" I asked.

"Nothing, needs a keyboard. I'll get one," Dave told me.

Dave came back with one of our SWTPC keyboards and wired it in after studying the schematic.

"Don't work," he told me. "Better call 'em."

So I called the number listed in the paperwork and asked for Steve.

"Which one?" the young man at the other end asked.

"The fast talker," I told him.

"Oh, Steve Jobs. Wait a minute." Steve came on the line, and I told him the keyboard didn't work.

"What kind of keyboard did you use? South West? Nah, they won't work. I'll send a good one and some software tomorrow."

"Wait." I told him I didn't need it Fedex next day–I could wait. Too late, he was gone.

Next day, another C.O.D. for $60 arrived, and a little plug-in circuit board with two chips on it arrived, and a cassette. Fedex collect. Again I called California for Steve.

"Got the keyboard? Good one! I'm going to buy a lot and we will get them cheaper. The little board, oh yes, that's the cassette interface, only two chips, Woz invented it, runs at 1200 baud. Great, you'll love it. the software is the "Game of Life."

All of this in one breath! I hung up.

Dave figured everything out and hooked it all up. It worked just as Steve said it would. The cassette interface was terrific. All the other ones we had ran at 300 baud and had a full board of chips and parts. This interface ran four times as fast and always got a good load. That alone was unusual. The Game of Life was very complex software for that time. It put figures representing cells on the screen. They lived, died, or reproduced, depending on their proximity to other cells, generation after generation. I was impressed. I called Steve and told him.

"Wait, Woz is working on BASIC. We should have it

Dede Veit and Apple cofounder, Steve Jobs, in The Computer Mart booth at the first computer show in Atlantic City in August, 1976. Steve is demonstrating the Apple I.

shortly," he said.

I also found out that Woz was his partner, Steve Wozniak, and he was the inventor.

Now it just so happened the New York Chapter of the Association For Computer Machinery (ACM) was holding a dinner meeting, and our store, together with other metropolitan area computer dealers, had been invited to show our equipment. This was a first experience for these big com-

puter people who had little contact with microcomputers. I knew other dealers were planning to bring large, complete computer systems. With the arrival of the Apple 1, I changed my ideas. I asked one of the hangers-on at my store to take the Apple, and mount it, the keyboard, and power transformer into a large attaché case. He did a great job, and I had a portable microcomputer. My wife and I went to the dinner, and all we took was the case, a 9-inch video monitor, and the cassette recorder. We seated ourselves next to the wall, where there were electrical plugs, and I quietly connected everything and loaded The Game of Life. The monitor faced the podium where the chairman was conducting the meeting.

He could not help but notice it. He stopped in his introductions and said, "What in the world is on that tube?"

I answered, "It's the Game of Life running on my computer."

"What computer? I don't see any computer. What are you talking about?" the chairman answered. Now he was really upset!

I got up and said, "My computer is in that case, and I am sorry, but I have it running just for practice. I did not think it would disrupt things here."

"You are telling me that there is a computer in that little case? What kind?" he sputtered.

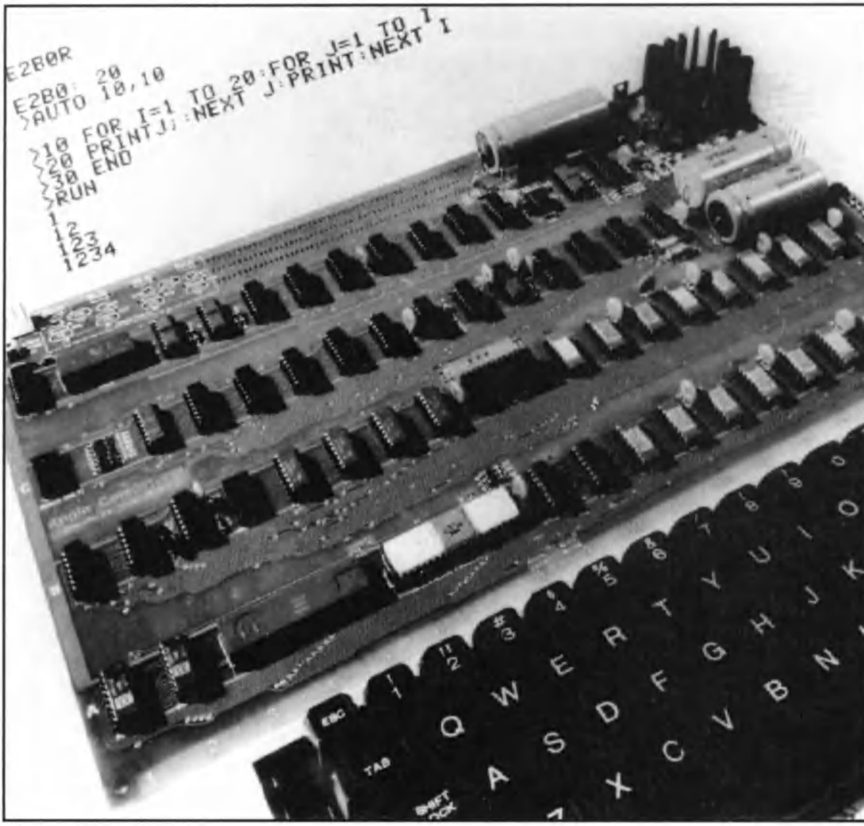
"It's the Apple," I replied.

"Apple? Never heard of it. Well, turn it off now!"

After the formal part of the meeting, all the computer dealers set up their equipment to demonstrate their products.

I waited until last and got up and said, "I thank all my fellow dealers for showing off their systems because we at Computer Mart sell exactly the same products. However, I have here the future of personal computing. It is called the Apple Computer, and it requires no expensive terminal and no big box of electronics. It's all here in this little attaché case, and I invite you to see and use it."

It was the Apple that caused the greatest excitement of the evening. However, they all asked me to call them when BASIC was available and when the little computer could be ex-



The Apple I

panded. I called Steve Jobs the next day and told him what had happened. He was even more excited than usual and told me Woz was working hard on BASIC, a typical Steve Jobs half-truth.

A week later, I went to a Processor Technology dealer's meeting at Emeryville, California. There were several telephone messages from Steve Jobs to me during the meeting. When I could break away, I called Steve at the number he left. He begged me to come down to Los Gatos to visit him that day. Not having any idea how far it was from Emeryville, I agreed and set off in my rented car. I arrived at the address, which turned out to be his sister's house, and Steve was there with Dan Kottke and another friend. He told me he had great plans, and Apple was going to be a big company. He

An Apple I used as a test and programming machine at Apple in the early days. The company has come a long way since then!

asked me to invest $10,000, and said he would give me 10% of Apple Computer for my investment.

Looking at this long-haired hippie and his friends, I thought, "You would be the last person in the world I would trust with my ten grand!"

What I said was, "Steve, all my money is invested in my store, but I will help you. I have a double booth at the big computer show in Atlantic City, New Jersey this August. If you come to the show, I will give you free booth space and publicize the Apple computer."

He was somewhat disappointed at my turn-down but quick to take advantage of my offer. Booth space was expensive, and the show was a sell out. "I don't know if we can raise the fare to get to the show, but if we can I'll take you up on your offer. Woz has just finished the Apple II prototype, and he is bringing it over to show you."

Apple Introduces the First Low Cost Microcomputer System with a Video Terminal and 8K Bytes of RAM on a Single PC Card.

The Apple Computer. A truly complete microcomputer system on a single PC board. Based on the MOS Technology 6502 microprocessor, the Apple also has a built-in video terminal and sockets for 8K bytes of on-board RAM memory. With the addition of a keyboard and video monitor, you'll have an extremely powerful computer system that can be used for anything from developing programs to playing games or running BASIC.

Combining the computer, video terminal and dynamic memory on a single board has resulted in a large reduction in chip count, which means more reliability and lowered cost. Since the Apple comes fully assembled, tested & burned-in and has a complete power supply on-board, initial set-up is essentially "hassle free" and you can be running within minutes. At $666.66 (including 4K bytes RAM!) it opens many new possibilities for users and systems manufacturers.

You Don't Need an Expensive Teletype.

Using the built-in video terminal and keyboard interface, you avoid all the expense, noise and maintenance associated with a teletype. And the Apple video terminal is six times faster than a teletype, which means more throughput and less waiting. The Apple connects directly to a video monitor (or home TV with an inexpensive RF modulator) and displays 960 easy to read characters in 24 rows of 40 characters per line with automatic scrolling. The video display section contains its own 1K bytes of memory, so all the RAM memory is available for user programs. And the Keyboard Interface lets you use almost any ASCII-encoded keyboard.

The Apple Computer makes it possible for many people with limited budgets to step up to a video terminal as an I/O device for their computer.

No More Switches, No More Lights.

Compared to switches and LED's, a video terminal can display vast amounts of information simultaneously. The Apple video terminal can display the contents of 192 memory locations at once on the screen. And the firmware in PROMS enables you to enter, display and debug programs (all in hex) from the keyboard, rendering a front panel unnecessary. The firmware also allows your programs to print characters on the display, and since you'll be looking at letters and numbers instead of just LED's, the door is open to all kinds of alphanumeric software (i.e., Games and BASIC).

8K Bytes RAM in 16 Chips!

The Apple Computer uses the new 16-pin 4K dynamic memory chips. They are faster and take ¼ the space and power of even the low power 2102's (the memory chip that everyone else uses). That means 8K bytes in sixteen chips. It also means no more 28 amp power supplies.

The system is fully expandable to 65K via an edge connector which carries both the address and data busses, power supplies and all timing signals. All dynamic memory refreshing for both on and off-board memory is done automatically. Also, the Apple Computer can be upgraded to use the 16K chips when they become available. That's 32K bytes on-board RAM in 16 IC's—the equivalent of 256 2102's!

A Little Cassette Board That Works!

Unlike many other cassette boards on the marketplace, ours works every time. It plugs directly into the upright connector on the main board and stands only 2" tall. And since it is very fast (1500 bits per second), you can read or write 4K bytes in about 20 seconds. All timing is done in software, which results in crystal-controlled accuracy and uniformity from unit to unit.

Unlike some other cassette interfaces which require an expensive tape recorder, the Apple Cassette Interface works reliably with almost any audio-grade cassette recorder.

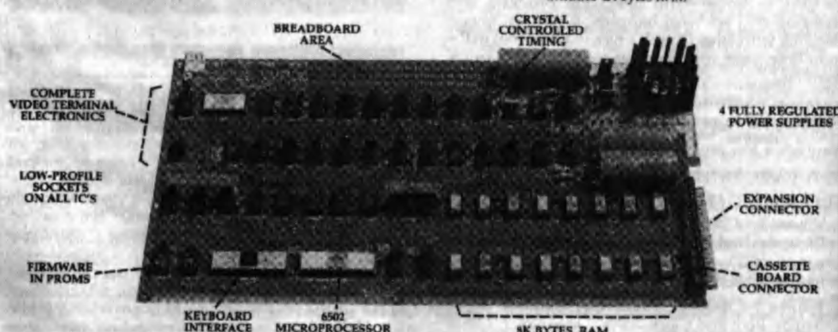
Software:

A tape of **APPLE BASIC** is included free with the Cassette Interface. Apple Basic features immediate error messages and fast execution, and lets you program in a higher level language immediately and without added cost. Also available **now** are a dis-assembler and many games, with many software packages, (including a macro assembler) in the works. And since our philosophy is to provide software for our machines free or at minimal cost, you won't be continually paying for access to this growing software library.

The Apple Computer is in stock at almost all major computer stores. (If your local computer store doesn't carry our products, encourage them or write us direct). **Dealer inquiries invited.**

Byte into an Apple $666.66*

* includes 4K bytes RAM



APPLE Computer Company • 770 Welch Rd., Palo Alto, CA 94304 • (415) 326-4248

The slick advertising and corporate image was to come later. In the beginning, Apple's first publicly marketed computer was a simple, single-board affair. You had to provide your own case and monitor. This ad appeared in the February 1977 issue of *Kilobaud*.

When Wozniak came over I was a little more impressed with him than Jobs. He brought a computer board with jumper wires all over and parts hanging off all over the board. This was to be the Apple II! After Woz hooked his haywire rig up to the living room TV, he turned it on, and there on the screen I saw a crude Breakout game in full color! Now I was really amazed. This was much better than the crude color graphics from the Cromemco Dazzler.

After a few minutes Woz turned it off and said, "I am still working on it; everything heats up after a while!"

"How do you like that?" said Jobs, smiling. "We're going to dump the Apple I and only work on the Apple II."

"Steve," I said, "if you do that you will never sell another computer. You promised BASIC for the Apple I, and most dealers haven't sold the boards they bought from you. If you come out with an improved Model II they will be stuck. Put it on the back burner until you deliver on your promises."

I suppose I wasn't much encouragement for the young businessman because I told him things he didn't want to hear, but a week later he called me in New York.

"We have the tickets, and we are coming to the Atlantic City Show. Woz almost has BASIC finished–we will bring it with us. Get me a room at the Hotel."

I called the Shelborne and was told there were no more rooms. So I doubled up two of my people and gave the room to the Apple characters.

On August 26, 1976, we all went to Atlantic City, New Jersey and the old Shelborne Hotel for what was to be the first national computer show, and the most important. We had our booth set up with our Apple I housed in a case with a monitor inside and the keyboard in front. It was a one-piece masterpiece made by a friend of mine, Mitch Bogdanowitz, who was a great model maker. We called the new desk top computer Eve, because she ate the Apple! Of course we also showed an Imsai, and we expected to receive our first SOL at the show. Half of the booth we saved for the two Steves and their Apple Computers. They showed up later in the day. Steve Jobs and Dan Kottke came into the booth and started to set up signs.

"Woz is in the room finishing BASIC. He's using the hotel

TV." said Jobs.

At this point my mother-in-law came over to Steve. She looked him up and down and said, "Young man, your backside is sticking out of holes in those jeans! You are NOT going to be in *my* booth like that. Take 'em off and I'll sew them up, now!"

Steve Jobs was more than a little surprised—I don't think anyone had ever spoken to him like that! However, you didn't fool around with Elizabeth Olivet, who was a very formidable Italian grandmother. Steve went behind a curtain, took off his pants, and handed them to her. She took out the sewing kit from her commodious bag and mended the worn jeans until they met her standards of modesty.

All Jobs said was, "Thanks, I think we better get back to the room to see how Woz is doing."

The next day, on August 28th, the show opened. Steve Jobs had several Apple I computers running—the new Apple Basic, and he had one encased in a wooden cabinet that he was really proud of. Their exhibit attracted a lot of attention, as well it should. In this show full of 8080 computers with large cabinets, flashing lights, and colorful switches, the Apple was the lone 6502-based machine. It was a single board, yet it had its own video display and ran full BASIC. In addition it could load from a cassette faster than any other machine there. Nobody who walked anywhere near the booth failed to be buttonholed by Steve Jobs, who told them in no uncertain terms what a great thing the Apple was. He even got press coverage—no mean feat in a show where the new SOL computer was introduced, where the Altair B dominated the largest booth, and where TDL showed the very first Z-80 CPU for the S-100 bus.

We did not get the new SOL during the show, but one was given to us at the end. When the show closed, the partners went back to California somewhat disappointed because, in spite of all the attention, they had not sold one Apple 1. Neither had I, although I had taken orders for several SOLs and a couple of Imsai systems.

The return from Atlantic City was a great letdown for the partners. Wozniak felt that he should be only working on the color version and that Jobs was keeping him from it. In fact,

Woz tried to sell the idea to Processor Technology, maker of the popular SOL computers. They relied on the advice of Lee Felsenstien, who didn't think much of Apple, and turned Woz down. Then Commodore came to Jobs as a result of the Atlantic City Show and wanted to buy the company as an easy entry into the microcomputer business. Jobs asked for $100,000 and fairly big salaries for the partners. Commodore thought the asking price was ridiculous from two young men working out of a garage, and luckily for Apple the deal fell through. They were just about at the end of their resources. The dealers had not re-ordered because the Apple 1 simply did not sell. I had to mark mine down below cost to get rid of them.

At this point, Jobs decided that they needed help with marketing, advertising, and public relations. Asking around Silicon Valley, he was given the name of Regis McKenna as a top practitioner of these arcane arts. Steve contacted McKenna for an appointment but was shunted to an employee whose

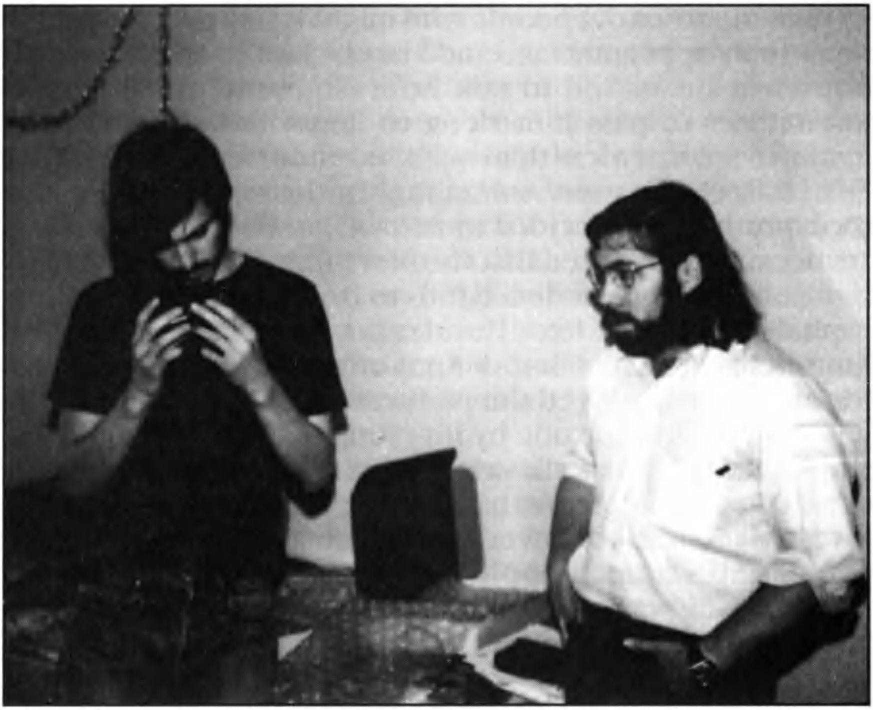
The Apple II with monitor and disk drives.

job was to screen out people who might waste the company's time. Job's appearance seemed to put him in that category, but when he started to talk he was able to convince the interviewer to pass him along to Regis McKenna himself. Again, in spite of a less than qualified endorsement from Paul Terrell, McKenna saw something in the two partners and their product. He decided to take on Apple as a client.

Because he realized that the first thing Apple needed was more money, he introduced Jobs to Don Valentine, a venture capitalist. Valentine liked the idea but did not invest in Apple himself because he felt it did not offer a big enough market for him. He introduced the partners to Mike Makulla, a man who had made a fortune by investing in the Intel company, and retired at 30. Makulla saw a future in microcomputers and decided to make Apple his venture into the business. He invested money, borrowed more from a bank, and with the two partners formed Apple Computer Company.

Wozniack was a hold out for the longest time because he wanted to keep his job with Hewlett Packard and moonlight with Apple as he had been doing up to that time, but Makulla wanted a 100% commitment from both partners as a condition for his investment. The company was incorporated in January 1977 and bought out the partnership completely. Makulla brought in Michael Scott as president because he felt that neither of the partners had the skills to run a corporation, and he himself did not want to become too deeply involved. Nevertheless, he was the engine that turned a garage workshop company into a major computer corporation.

I spent the year after the Atlantic City show selling SOL computers, SWTPC computers, and developing a dealership in Alpha Micro Time Sharing computers. However, when Apple IIs started to arrive, they slowly built into our major line, displacing the SOL and SWTPC 6800s. The Apple II changed the entire business. No longer did solder iron wielding techies hang out at our store–the Apples came completely built and ready to run. The Apple disk system was priced within everyone's price range, and soon there was a lot of very useful software for it, lead by Visicalc, the most important program. Businessmen would come into the store to buy "A Visicalc Machine" and that's all they used it for. In



Steve Jobs and Steve "the Woz" Wozniak—founders of Apple Computer—in 1976. They sold their most valuable possessions to start up the company. Jobs sold his Volkswagen microbus and Wozniak, his two Hewlett-Packard calculators. Today they are worth many millions. Photo courtesy of Apple.

the Apple II users, we saw a different type of enthusiast. The Apple users did not mix very well with the S-100 users, just as there is a division between the Mac users and the MS-DOS users today. In New York City, The Big Apple Club was formed just for Apple owners and met at our store. The Apple users were much more oriented toward software and graphic applications. They were more interested in what a computer did then how it did it.

Being the major Apple dealer in New York brought us a lot of business and growth, but then trouble struck The Computer Mart of New York. I had signed a very large purchase order with Apple, and I distributed the extra computers to several other Computer Mart stores, with whom I was loosely

allied. We all got a good volume price from Apple, who only had to deal with me instead of five other stores. I marked the machines up 5%, for my trouble and expenses in distributing them.

This worked well for all until Apple decided to open a distribution center in Boston under control of my old competitor and friend, Dick Brown. My contract was canceled, and I was told to buy through Dick Brown. This would work no hardship on me, but my fellow Computer Mart owners in

By October 1979—when this fellow wearing a Pascal tee-shirt appeared in an ad in *Byte*—Apple's advertising had gotten much more sophisticated and its Apple II computer was wildly successful.

Boston, Vermont, and New Hampshire were in direct competition with Dick Brown's Computer Store, and they did not trust him to deal fairly with them. This was particularly important because there was an acute shortage of Apple disk drives, and people would buy only if they could get a disk drive. Instead of signing with Brown immediately, I tried to reach Steve Jobs to make some other arrangement to get our computers. Not only did he refuse to talk to me, but all my computer shipments were stopped.

Finally I decided my friends would have to shift for themselves, and I signed with Brown. It took some time for me to get my orders back into the pipeline, and I lost a lot of sales to other dealers in the New York area. This loss of business, coupled with the closing of Processor Technology, finally did in my business in 1979, and I left the retail computer store.

People who have read my articles often ask me if I regret refusing Steve Jobs the $10,000 investment for 10% of Apple, which is now a multi-billion dollar business.

I always answer, "No, I did not lie to Steve Jobs. Every cent I had was invested in my own store. I tried to help him in every way I could, but when I needed him he turned his back on me."

I did not see Steve Jobs for a few years after the store closed, but I heard plenty about him. Then one day my wife Dede and I were crossing Central Park West after a walk in the park. As we emerged near the Tavern On The Green we saw a party of young men and women heading for the Tavern.

All of a sudden my wife stopped and exclaimed, "My God! Steve Jobs in a three-piece suit!"

He looked at her and smiled, the very picture of sartorial perfection. "Hello, Dede, you sure know how to humble a fellow."

There was never anything humble about Steve Jobs.

6  CROMEMCO: INNOVATION AND RELIABILITY

One morning in 1975, Leslie Solomon, technical director of *Popular Electronics* magazine, entertained two visitors in this office who had designed some interesting electronic projects for the magazine.

A more unlikely pair of collaborators you could not imagine. Roger Melen was an intense giant who stammered when he got excited. Harry Garland was a small, quiet man who preferred to listen, evaluating everything before speaking.

Although opposites, they worked as partners for many years. At that time they were graduate students at Stanford University and wrote electronic construction articles for *Popular Electronics* to help pay tuition.

They had come from California to talk to Les Solomon about a T.V. Camera project called "Cyclops" that they were designing for the magazine. Les Solomon's office was small and filled with electronic gadgets, so with three people it was quite crowded. The partners quickly noticed a strange piece of gear they had never seen before.

"What is *that*?" said Melon, pointing to a blue, amplifier-sized cabinet with red and green lights, and rows of toggle switches on the front panel.

"Its a computer." replied Solomon. "It's the Altair. Watch this." Les started flipping switches on the front panel and the lights changed as he worked. He was entering the tape

loading program, one byte at a time. Soon the teletype® went "click," and Solomon started to feed a punched paper taper through the tape reader on the teletype.

"I am loading BASIC now," he said.

After a few minutes they were running crude BASIC programs and games like "Hangman." It was enough–the partners were caught forever!

On their way back to Palo Alto, California, they detoured and stopped at Albuquerque, New Mexico to talk with Ed Roberts, president of MITS, who made the Altair. They had decided to go into business developing peripherals and expansion boards for the Altair, and the first thing they had to do was buy one. This was not so easy because Ed Roberts was up to his neck with unfilled orders for Altair kits, and he wasn't about to just sell and deliver one to these two strangers, even if Les Solomon had recommended them. Solomon had been the one who acted as contact for the magazine which had promoted the Altair with a cover story in *Popular Electronic*s, and Roberts felt greatly indebted to him, but he really was in a hole for deliverable computers.

In addition, Roberts wanted to be the sole developer of Altair expansion boards. The partners told him that what they had in mind was non-competitive with MITS and would greatly enhance the Altair, not merely expand it.

The final clincher was delivered by the quiet Harry Garland, who convinced Roberts that someone had to design video and graphics boards for the Altair, and that they were the ones who could do it. They got the Altair, and upon their return to California they formed Cromemco Incorporated, taking the name from Crothers Memorial Hall, their dormitory at Stanford University.

Their company was located in Stanford, and they called themselves "Specialists in Computer Peripherals."

The Bytesaver

Remembering the complicated procedure Les Solomon had used to load the teletype and energize the Altair, Cromemco's first product was called the "Bytesaver." This Altair-compatible plug-in board enabled the owner to program the new erasable EPROM (Erasable, Programmable,

Cromemco's computers, like the Z-2 above, were *sturdy* and reliable.

Read-Only Memories) right in the computer. It used either 2708 (1K), or 2704 (512-byte) EPROM. The board could hold up to 8K of memory, and once it was programmed it did not forget when power was turned off. It remained in the computer, and its pre-programmed memory could be used merely by turning on the machine. If the program had to be changed, the chips could be erased by ultraviolet light through a small window on the chip and then be re-programmed.

The Bytesaver proved to be a very popular peripheral for the Altair and IMSAI computers, which were starting to appear all over the country. With it, a monitor program could be installed in the EPROM so that when the computer was

turned on it was ready to go. These days, we expect this kind of thing, but in 1976 it was a great advance in microcomputer technology. The Bytesaver was first advertised in *Byte* magazine in February 1976. It cost $195 in kit form, or $295 assembled and included one 2704 EPROM chip.

The TV Dazzler

The second board Cromemco made more than fulfilled the promise the partners made to Ed Roberts. It not only provided graphics, but displayed them in color for viewing on a color monitor or color TV set. It was called "The Dazzler" and it used DMA (Direct Memory Access.)

The Dazzler formatted each memory byte into a point on the CRT screen to give a 128 x 128-element picture. Its output was an NTSC signal observable on a color monitor or TV (nobody had a color monitor those days, except TV studios.) You had to go through an RF Adapter to feed a T.V. set through the antenna terminals. This might not seem very impressive today, with VGA color almost standard for PCs, but in those days it was like a miracle.

Not even the largest minicomputer manufacturers had anything like the Dazzler. Cromemco provided not only the hardware, they made software available too. For only $15 apiece, you could buy a punched paper tape of The Game of Life in full color, Kaleidoscope in full color, or Dazzle Writer for alphanumeric displays in color. The Dazzler was built on two boards, but it only needed one connector on the computer motherboard. It cost $215 as a kit, or $350 assembled. Ed Roberts gave the Dazzler a big send-off at the First World Altair Computer Conference in March 1976.

Cromemco's S-100 Boards

Living up to their slogan as "Specialist In Computer Peripherals," Cromemco developed a series of excellent plug-in boards for the S-100 Bus (as the former Altair bus was now called.) Their products were noted for both innovative design and quality construction. Cromemco was not out for the quick buck as many other manufacturers were. Perhaps it's for that reason they lasted longer than most of the others.

For years in the late 1970s, you could count on seeing Cromemco's full page ads as the first first page or two of magazines like *Byte*. The company followed a twofold strategy in advertising, appealing to both business (as here) and to computer hobbyists, who were still the mainstay of the personal computer industry.

The D+7A Analog Interface board was one of the most important peripherals that Cromemco ever made, because it provided a gateway into the world of scientific and industrial computing for the S-100 computers. The D7+A was a high-performance board which provided seven channels of 8-bit analog-to-digital conversion. This enabled input to the computer from control equipment which produced analog output. It also provided seven channels of digital-to-analog conversion to output computer signals to analog devices.

In addition, it had an 8-bit parallel I/O port, to input and output data in digital form. It could perform the conversions in 5 microseconds, which at that time was lightning-fast. Prior to the availability of the D+7A, the only methods of perform-

ing such conversions and controlling analog devices were through specially equipped minicomputers that cost 10 times as much as an S-100 computer equipped with this board. The D+7A sold for only $145 in kit form or $345 assembled. Once we had this board to sell, I notice a large increase in orders from universities and laboratories.

Cromemco also improved the Cyclops optical data digitizer (it could hardly be called a camera) so it could be used for image recognition and process control scanning. Cyclops provided 32 x 32 pixel images using a f2.8 25mm lens. It needed a special controller to give software control of exposure time, frame rate, and memory allocations for picture storage. Although unbelievably crude by today's standards, the Cyclops was a beginning of the use of CCD devices for video imaging. This is how video cameras work today! The Cyclops sold for $195 in kit form, or $295 assembled. Cromemco also sold a joystick to enable users of the Dazzler to draw images directly on the screen and provided the software to operate it.

The ZPU Processor Board

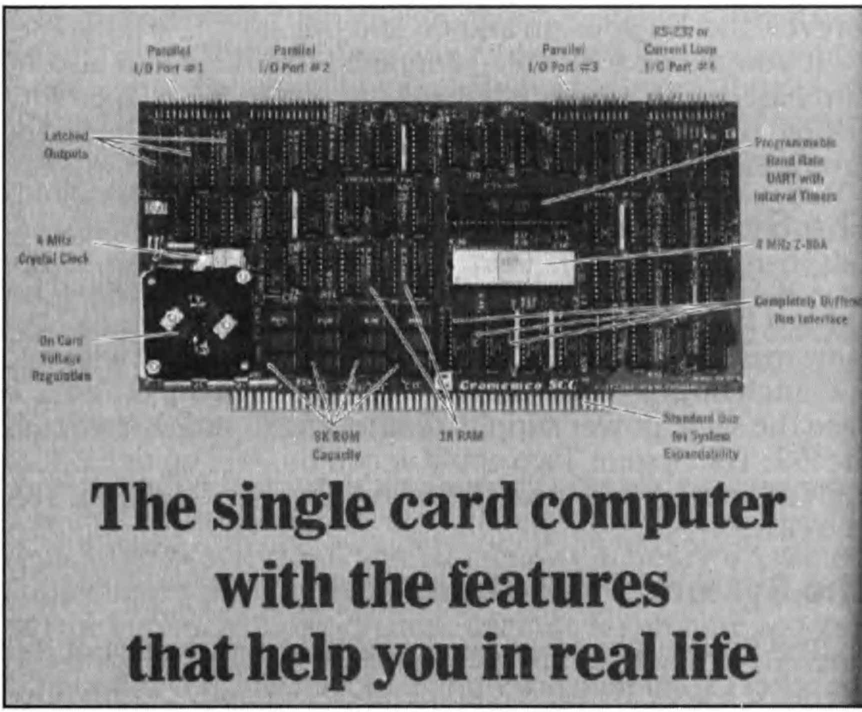
The Zilog Z-80 CPU attracted a lot of attention in the microprocessor world. It only required one voltage in place of the two required in the Intel 8080, and it could run at twice the speed. In addition it had an enhanced instruction set, although it incorporated all the 8080 instructions and was a direct replacement for that older CPU. Technical Design Labs of Trenton, New Jersey had introduced a S-100 CPU using the Z-80 (Digital Group had introduced a non-S-100 Z-80 CPU) at the first Atlantic City Computer Show, but Cromemco felt it could be improved so they designed their own Z-80 CPU. Chromemco used the Z-80/4 version of the chip, which was certified to run at the blinding speed of 4 MHz! Because most memory and I/O chips could not run at that speed, Cromemco provided a switch that allowed the user to select either 4 MHz, or 2 MHz operation. In addition the "ZPU" was designed to have power-on jumps to any 4k boundary. This enabled the use of automatic power-on operation of the computer.

Today, we expect the computer to start-up when we turn it on (hopefully!), but in 1976 this was advanced technology.

Even minicomputers and mainframes needed "boot-strap" loaders and "ILP" loaders. Cromemco expected faster versions of the CPUs and memory chips, and so provided for jumper-selectable wait states. This simplified interfacing with existing memory and I/O chips even while operating at 4MHz. The ZPU was able to be installed in existing Altair or Imsai computers, and it included the powerful Z-80 monitor program at no extra cost. For those owning Bytesavers, the monitor program could be obtained in a ROM for instant operation. (This is equivalent to our modern BIOS chip.) The ZPU sold for $295 in kit form, or $395 assembled.

The Z-2 Computer

Once the CPU was available, Cromemco took the next step toward becoming a computer manufacturer rather than just a peripherals maker.



For the computer hobbyist, Cromeco offered the option of buying just the CPU card. Add some sort of mother board and a power supply, and you had a high quality personal computer.

They bought a mainframe from Imsai and installed their own ZPU, I/O boards, and memory boards. The famous red, white, and blue front panel now bore the title "CROMEMCO Z1," and the performance was much improved. Of course this was only a stop-gap. Cromemco was hard at work designing a completely new type of computer.

The new Z-2 Computer was housed in a massive square metal cabinet. It was said that circus elephants could stand on a Z-2 without damaging it. It had a shielded S-100 bus with 21 slots for the growing family of Cromemco plug-in boards. Tens of thousands of these Z-2 computers were used for dedicated applications, with the programs burned into ROMS. They still may be found in labs and factories all over the world, working away, day after day, year after year. I doubt if any other computer has ever achieved the record of the Cromemco Z-2, and I doubt if any ever will. With no rotating components, in addition to static memory and boards designed to last forever, the Z-2 goes on and on and on.

If you needed variable programs, the Z-2 could also be purchased with a 11 Mbyte hard disk as the Z-2 HD, or with floppy disks as the Z-2 FD. The disk versions used the Cromemco version of CP/M called CDOS.

The System Two Computer

The Cromemco System Two Computer was designed for use in a business environment, or for general use. It had the same massive cabinet as the Z-2, but it was equipped with two 5.25-inch floppy disk drives for a storage capacity of 780K. It used the same power supply, motherboard, and I/O board as the Z-2. The System Two could accommodate up to 512K of RAM at a time when most business computers had from 48K to 64K.

The System Three Computer

The System Two was a very practical computer, but like the other Cromemco machines it looked like, it was designed to be installed in a lab or factory, not an office. Cromemco realized that it was losing the largest part of the business with its ugly duckling computers, and set to work to design a

business computer. The result was the Cromemco System Three, a very attractive computer built into a desk. It used either two or four 8-inch floppy disk drives. To compliment this attractive platform, Cromemco provided printers and video terminals that matched the design of the System Three. Dealers selling this system were specially trained and carefully selected.

The System Three used the CDOS operating system for single-user operation, but Cromemco also provided the CROMIX multi-tasking, multi-user operating system, a version of Unix. Cromemco also provided a complete range of software including COBOL, FORTRAN IV with the RATFOR pre-processor, 16K BASIC, Micro Assembler, 32K Structured BASIC, Word Processing, Data Base, and Graphics.

Cromemco used the ill-fated Persci 270 floppy disk drives that caused Processor Technology and Alpha Micro such trouble, yet side-stepped the problems that afflicted other manufacturers who used the product. The Persci 270 had two 8-inch drive sections using one motor and frame assembly. Processor Technology incorporated that drive family in its Helios Drive System, an unfortunate decision which loomed large in the demise of the company. Cromemco avoided a similar fate because it removed the heavy drive bezel, a piece that often caused the frame to twist, thus throwing the drive out of alignment. The System Three bezel was part of the front panel of the computer and did not stress the drive. In addition, the usual Cromemco quality control negated trouble before it happened.

System One Computer

Not everyone wanted, or needed, a desk-sized computer system, so Cromemco developed a desktop computer with eight S-100 slots and 64K of RAM memory. It had two 5 ½-inch floppy drives providing 780K of disk storage. It was able to run the complete range of single-user CP/M software and was clearly designed to compete with the North Star Horizon computers. A second model was equipped with a 5 Mbyte hard drive. By adding extra memory as well as the hard drive you could even run CROMIX multi-user software, thus allowing several people to use the computer at once.

System Zero Computer

This model was practically the last Z-80 computer developed by Cromemco. It was designed as a small footprint machine for use in labs where it would be operated by ROMs much as the Z2 was. For general use, a second chassis holding either a hard disk or two floppies could be stacked on top of the computer cabinet.

What Happened to Cromemco?

Although Cromemco was one of the last S-100 computer firms to go, it finally succumbed to the end of the 8-bit computer world for commercial uses. The entry of IBM into the personal computer market practically destroyed most of Cromemco's business, and in 1986 the company had massive lay-offs because the business had been reduced to system maintenance and parts replacement. The company was sold and became the Cromemco Division of Dynatech Corporation. Roger Melen and Harry Garland left the company.

7 THE SPHERE FROM BOUNTIFUL

Not getting the Altair to sell in my new computer store was a terrible disappointment. However, I still felt that I could make a go of it. The Altair might have been the first microcomputer available, but now there were others.

Coming from a big computer, time-sharing environment, the machine that looked the most practical to me was called The Sphere, and it was made in a place called Bountiful, Utah. I had no idea where that was, but it did sound very reliable to me. Not only that, but their ads said the Sphere was a real business computer. It was, in fact, the first real desk top personal computer. It used the Motorola M6800 processor, and had a built-in keyboard and CRT so that it did not need a teletype or other terminal. In addition, the Sphere company offered a full line of peripherals including printers and disk drives. You could buy the Sphere with as much as 32,000 words of memory! Surely this was a real computer, and the one that I should sell to business people.

I started calling Sphere to ask about becoming a dealer. Funny, except for Ed Roberts of MITS, when I told any of these companies that I wanted to sell their computers in New York City, I got a lot of attention.

The folks at Sphere were no exception. They answered all my questions. Yes, as a dealer I would get at least a 25% discount. Sure they had an excellent BASIC, and all kinds of application programs were going to be written in their BASIC. I could get a cassette interface to load programs and

save data. It was built into the Sphere; all you had to add was an ordinary cassette recorder with a remote mike control. Even a $30 one would work. The more I heard, the more impressed I was. The Sphere came as either a kit, or you could get a factory built and tested machine.

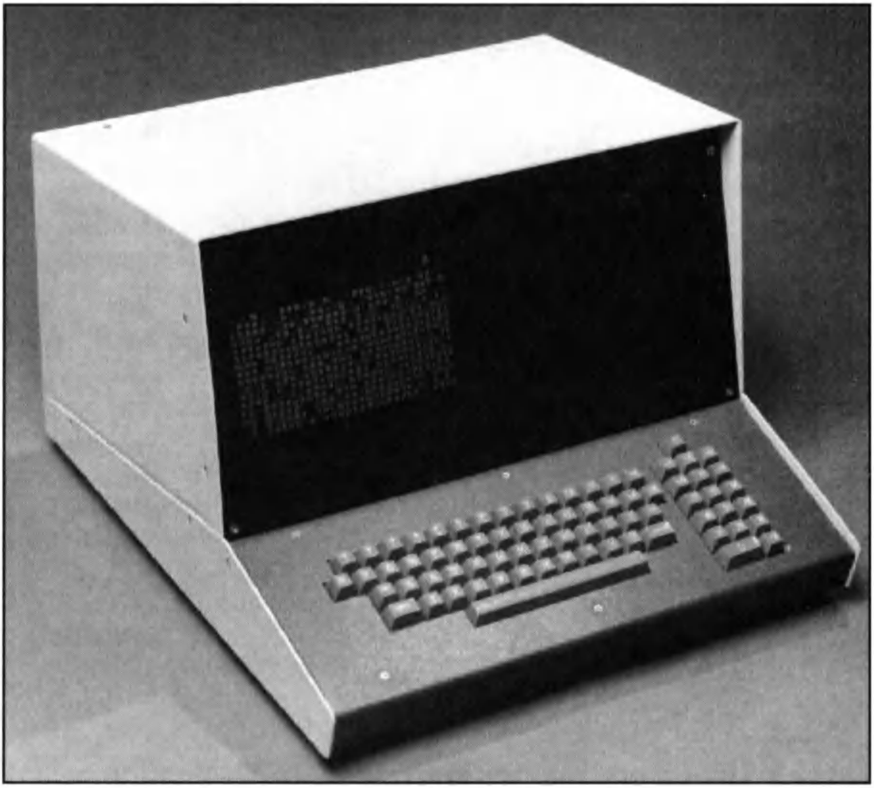
Sphere had started to advertise in the very first issue of *Byte*, in September 1975. They had previously advertised in *Popular Electronics*. In the first *Byte* ad they offered their Introductory Offer consisting of three models, the first a Hobbyist 6800 computer kit with 4K of memory and a keyboard for $650. Then they offered a Intelligent System, with firmware assembler, editor, loader, 23-key keyboard, and a 16-line by 32-character display, as a kit for only $750. Finally they had a model with 20K memory that ran BASIC and came with a cassette interface. This cost $1,345.

They also offered their CPU board as a stand-alone control board for computer-controlled applications. It was quite impressive to the world, who knew nothing about microcomputers as yet. By the second issue of *Byte*, Sphere was advertising on three pages and telling everyone to buy now because after September 30th the prices were going up. In this issue, Wayne Green, the publisher of *Byte,* was reporting on a trip he made to visit some of these companies to see if they were real. He reported on a visit to Sphere where Mike Wise, the President of the company, showed him the system which was on three boards, a CPU, a memory board, and a keyboard/character generator & I/O board.

Wayne predicted that the new factory would soon be too small for Sphere because of the great interest in their system. By December, Sphere was placing ads claiming that their complete computer system with BASIC cost less than anyone else's video terminal. Mike Wise also set out across the country, visiting computer clubs and demonstrating his computer. In January 1975, I seriously started to acquire lines to sell in a computer store, and of course I phoned Sphere to talk with them. I first spoke with Mike Wise, but he turned me over to Douglas Hancey, the marketing manager.

Doug told me he was making a business trip east to speak with a number of people who were interested in dealerships, and he would contact me in a few weeks. I had divided my

Sphere's ad in the first issue of Byte (September 1975). The Computer Mart of N.Y. was one of Sphere's first dealers. My wife Dede named my first Sphere SOSCS (Stan's Own Sphere Computer System) pronounced "SOCKS."



The Sphere System 340

time between looking for a store location and looking for a job in case the computer store idea did not work out, so time went very fast.

Within a week, I received a frantic phone call from Doug Hancey. He was in New York, and either he had lost, or someone had stolen, his wallet. He was at the American Express office getting a new card and some money, but he had no identification. I was the only person he knew in New York City who might identify him. I went right down to American Express on 42nd Street and met Doug. At least he said he was Doug, and I had to identify him although I had never met him! I took a chance, because he sounded like the man I had talked with on the phone. With a new American Express card, some money, and the promise that American Express would help him with his missing airline ticket, Doug

managed to pull himself together.

I took him home, and we talked about computers. Doug told me that he had been in Boston to see another dealer who wanted to open a computer store, and strangely enough he had picked the same name as mine. Doug suggested that I contact Charles Dunning about working together. He told me all about the great plans of Sphere and why the Motorola 6800 was better than the Intel 8080. From everything he said, the Sphere System 3 was a real business computer and just the thing to start a store in New York City. He also suggested that I buy a factory-built machine so I could get started sooner. Doug might have been a hayseed about the ways of New York, but he was a very good salesman. He left with my check for a factory-built Sphere System 3 computer and a System 3 kit. I also ordered three more kits, to be paid for C.O.D. when they were ready. I was in the computer business—now all I had to do was find a store.

A couple of weeks later, the factory-built Sphere arrived. It had a case, like that of a computer video terminal, with a front screen and keyboard. In the back were three circuit boards interconnected by ribbon cables with tiny connectors at each end. The connectors plugged into ordinary chip sockets on the circuit boards. Emerging from the back was also a thick bundle of wires, which ran into a second large metal box. This was never shown in any of the pictures and turned out to be the power supply. Of course I had never seen a microcomputer so I had no idea what one should look like. I was impressed with the Sphere until I learned more about its ways. My wife promptly named it SOSCS (Stan's Own Sphere Computer System) pronounced "SOCKS."

Now I had a lot to do. First I had to learn all about programming using the mini-assembler that came in the Sphere's ROM and at the same time get ready to go into a business no one had ever been in before!

Frankly, after working with the Sphere I became somewhat disillusioned. It had a lot of good design features in the circuit boards, but the mechanical assembly turned out to be a nightmare. There was little thought to holding the circuits rigid, and they just stood in slots in a metal guide. To make matters worse, the ribbon cables that connected the boards

were always coming out of their sockets. Why someone hadn't thought of using a socket system with a positive lock was a mystery to me. The electronics catalogs were full of them. A careful and workable electronic design was marred by saving a little on sockets. The other problem was the power supply. Located at a distance from the power-using boards, it simply did not put out enough power to overcome the voltage drop in the cable and the power demand of all three boards. When Con Edison dropped the power level in New York, the Sphere simply did not work. The promised free BASIC turned out to be just that, a promise. All we had to work with was the mini-assembler.

When I called Sphere with all these problems, they thanked me for all the feedback and said they would correct all the problems. I was told that my computer was the first System 3 they had ever built and that they would replace it with a later model, at no cost to me. Meanwhile, I held the boards and connectors in place with the universal cure-all, duct tape, and learned Motorola 6800 machine language. This experience did one thing for me, I learned that I was not the only tyro in the microcomputer business, and that I better not put all my eggs in one basket. I ordered ten Imsai computers!

Almost the first day the store was opened, a bearded young man come in and looked around. He watched me trying to program the Sphere, which refused to compile my code.

"What are you doing?" he asked.

"Trying to program something into this damn Sphere computer," I answered.

"Your format is wrong," he told me.

"Who are you, and what do you know about the Sphere?"

"I am Dave Levine, and I don't know anything about the Sphere, but I do know 6800 assembler, and your format is wrong. It will never compile that way."

I was perfectly willing give the job to someone else. "Here, you try it," I told him.

"I can't fool with it now. Give me the book, and I will come back tomorrow with it all done."

So I gave him the book and he left.

True to his word, Dave came in the next day just as I was going to lunch. He handed me a sheet of paper with assembler code written all over it. "Here, try putting this in, but do it exactly the way I wrote it. The format is just as important as the code."

"Tell you what," I told him. "I'll buy you lunch and when we come back you do it."

"Deal," he replied. "Let's go eat sushi."

So we went to a place where you sat at a counter, and plates of sushi came past you on an endless belt. Dave was very good at grabbing the plates as they went by, and we soon had our fill. When we got back to the store, Dave went behind the counter and entered his program. This time it compiled, and there, when the program was running, I could type something on the keyboard and it appeared on the screen! Wonder of wonders! We could not yet save the program because we had not figured out exactly how to set the tape recorder. It turned out that you could not use a $30 tape machine. It had to be a good quality recorder.

From then on, Dave worked at Computer Mart. That is, whenever he *was* there. He usually came in at 10:00 a.m., went to lunch at 12:00, and left at 3:00, unless he was interested in something he was working on. Dave became my technical and programming expert, and worked with me for years.

The Sphere kits that they sent me were never complete, and parts were always back ordered. The BASIC that finally arrived was terrible. It was so slow that it was impossible to use it for anything practical. If I had depended on the Sphere I would have been out of business in short order. However, I decided to give it one more chance.

We were going to exhibit at the first computer show ever held. This was the famous Trenton Computer Show in 1976. I decided that since everyone else would be showing Altair and Imsai computers, I would bring the Sphere. Secretly, I hoped to sell it at a loss, just to get rid of it. We set up our booth, and word spread among the attendees that someone was there from Sphere. Just the mention of Sphere set off a fire storm at the show. While Sphere was not too good at building computers, they were great at advertising, and what

The November 1975 *Byte* sported a two-page ad for Sphere, from which the above was extracted. Although almost anyone who had bought a Sphere product had complaints, the computer magazines were not as critical of the precious few advertisers then existing.

---

there was of the computer press at that time was not critical of its few advertisers. Lots of people had bought Sphere computers and computer boards direct from the factory, and almost every one had a complaint. They all headed to my booth to express their ire in no uncertain terms. It did me no good that to explain that I was not from Sphere, but only a dealer from New York. I had to leave the booth and hide.

Dave, however, sat at the Sphere and made it work. The only problem was that DEC had a big DEC-10 running a model railroad, and every time they gave a demo they sucked all the power out of the single power line that ran the length of the hall. Everybody's computer crashed, to the glee of the DEC representatives who knew that all our computers were just toys. Dave did show the irate Sphere owners that the machine could be made to work. But he got tired of that after a while and shut down the whole thing. Meanwhile, I was enjoying the show after removing my Sphere Badge.

That show finally convinced me that Sphere was completely inept at best, or swindlers at worst, or a bit of both. The Sphere just sat on my counter and looked impressive with store ads on the screen. If someone came in, impressed by their ads, I pointed out the defects of the machine and sold them an Imsai, Sol, or South West Tech 6800. They did list me as their New York dealer, and that brought a lot of customers

into my store. Sphere was always good at advertising.

One day I received a phone call that completely amazed me. "This is the IBM Watson Laboratories purchasing department. Are you the Sphere Computer dealer in New York? "

"Yes," I answered, but I thought, "Am I being kidded?"

"Well, we want to buy a Sphere. What do you have?"

"I have a complete System 3 ready to ship," I answered.

"Fine," the IBM man said. "How much is it delivered?"

"Its $2,900, plus $50 for delivery," I quoted him.

That would get my money out of the assembled Sphere.

"When can you ship it to us?" Mr. IBM asked.

"I can ship from stock in five days."

"Perfect," he answered. "I will send you the purchase order today. Here is the number so you can start packing it."

The Sphere single-card computer offered in the December 1975 *Byte*.

When Dave came in I told him the good news.

He told me, "I have a lot of work to do before we ship it."

Dave worked for two days on the Sphere, he was so glad to get rid of it. He cleaned it up like new and installed card guides made from model rail. If Sphere had Dave to do their mechanical design, they would have had a much better computer. I packed the Sphere and shipped it to IBM as fast as I could. A week later, I got another phone call from IBM. My heart was in my mouth as I answered.

"You didn't send us an invoice on your purchase order for one Sphere Computer."

"Oh, I put it in the box with the computer."

"Well, that is not the proper procedure. Didn't you read the purchase order?"

"Well, yes, but not the print on the back," I told her.

"That's okay. Just send me an invoice today. I'll send your check right out. I have to pay by the 15th."

And that was the end of the Sphere. I have no idea what IBM ever did with it, but I bet they laughed, even with all our improvements.

Sphere had one last hurrah with something they called Micro-Sphere. This was supposed to be a complete small computer with keyboard, video interface, and software all wrapped up in a white plastic case. The Micro-Sphere was widely advertised for a short time, until it was discovered that it was a compete fraud. The pictured computer was made of plaster, and Sphere had never built the real thing.

The day of "let's advertise something, and if we sell enough we'll build it," was over. The industry had moved into the era of competition.

Before they went under, Sphere tried to collect for all of the incomplete kit parts they sent me and threatened to sue.

"Come on to New York and sue," I told them and packed all their stuff into a box which I sent to Utah.

I think the good Mormons who had invested with Sphere became disgusted and forced Mike Wise to resign. Doug Hancey tried to re-organize the company but failed. So Sphere passed into history with their contribution of the first all-in-one desktop personal computer. The first real computer to use that idea was the Radio Shack TRS-80, Model III.

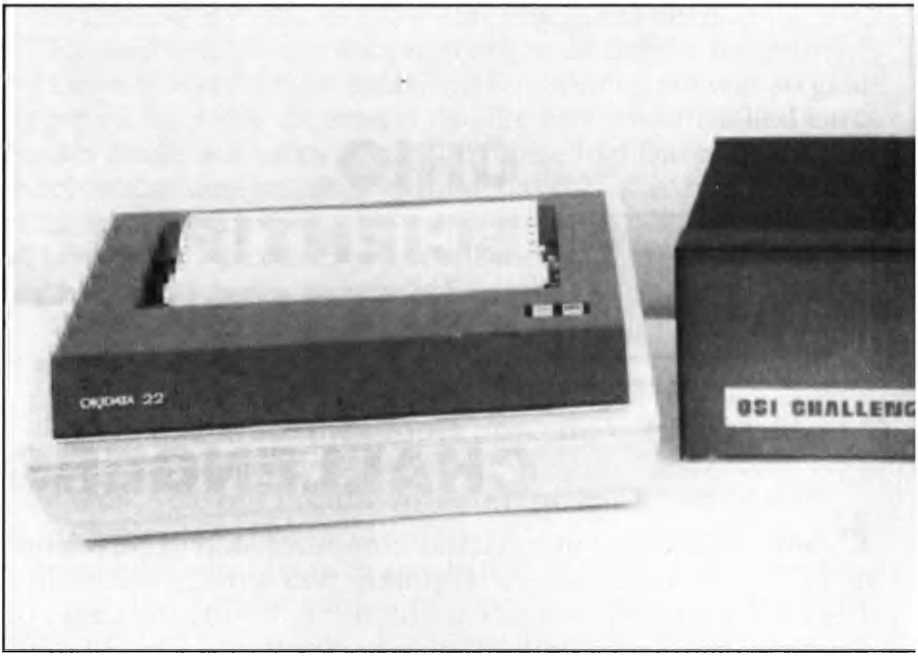
8

OHIO SCIENTIFIC: PIONEER OF THE CHALLENGERS

From the first day I opened the Computer Mart of New York in 1976, my store full of computers was a magnet for kids. They hung around as much as I let them, bright and eager to get their hands on a computer, *any* computer. I let them sit at the teletype and play Star Trek whenever it was not too busy, but many of them really wanted a computer they could own.

One day I read an ad in *Byte* Issue #6 for a computer trainer based upon the 6502 microprocessor, the CPU for the Apple and Commodore computers. The trainer came completely assembled with an instruction book, and only cost $99. Not only that, but after completing all the instructions and learning about the microprocessor, the student could return the trainer and trade it in for a single board computer kit, or for a blank board with instructions to build the Ohio Scientific Instruments Superboard computer. If the trade was made, the trainer only cost $10 to use. This seemed like the perfect thing to start the kids on, so I called Ohio Scientific Instruments and asked to become their dealer.

Thus, I began my long association with Mike and Charity Cheiky, the founders and owners of OSI. We met in person at the first computer show ever held, the wonderful Trenton Computer Show of 1976, when people from all over the U. S. came to New Jersey to see, touch, and talk about the new wonder, the microcomputer.



A complete OSI personal computer system (one of the first

Mike and Charity and their Ohio crew had come to show their Superboard System. The OSI 400 Superboard could be built with either a 6502 or 6800. You could populate it with eight 2102 Memory chips for a full 1024 Bytes (K) of RAM, 512 Bytes of ROM, an ACIA serial interface chip for RS-232C interface or 20 MA current loop interface, a PIA for 16-parallel 1/0 lines, and a power supply. Then, if you had a terminal, you had a complete computer. You could also expand it with one of Mike's memory boards, or video boards and a backplane board, into a complete OSI 400 Computer system. You could buy a kit, or just the circuit boards, for only $29 each.

OSI would also sell you all the "hard to get parts" at a reasonable price. Mike had also designed a floppy disk interface (probably the first one for personal computers.) The documentation and schematics were primitive. Manuals consisted of Mike's design sketches printed with his handwritten notes, and it was a little hard to figure out just which notes applied to the version you were building. However, one hobbyist helped another until they got it "up and run-

microcomputers with floppy disk drives as part of the system).

ning," and the finished product was a very good computer.

When OSI completed their first complete "factory built" computer, called the Challenger, Mike and Charity brought it to New York, and I hired a meeting room at the Hilton to give the first public demonstration. I invited everyone I knew who had an interest in personal computers, and it was a success in New York. When OSI showed the Challenger all over the US, they developed a loyal following for their equipment. It was not as large as the IMSAI, Altair, or SWTPC 6800 crowd, but much more committed to Mike's ideas and designs. Other designers packed as much circuitry as they could into the smallest possible space, thus creating neat packages, but also creating excess heat and Radio Frequency Interference (RFI.) Mike Cheiky built computer boards that were large and had few parts on them. These boards could be expanded and still meet the Underwriters Lab specifications for electronic equipment. OSI used its own 48-pin bus with a plug-in motherboard, made with low-cost Molex® pin connectors that provided trouble-free connections. The OSI cabinets were large, with

This "Take a Giant Step Forward..." was on the first page of an 8-page advertising insert from Ohio Scientific in the October 1979 *Byte*.

lots of room for convection cooling without a noise-creating fan.

The price of the Challenger computers was much lower than other computers of that time, and they came completely assembled. The Basic Challenger 65-IK (1K of RAM!) with serial interface was $439. If the IK board sounds strange to you, it was because you could keep adding chips to an OSI memory board. (They didn't sell a board without chips because they needed some to check out the machine.)

With the Challenger 4K model for $529, you could run Tiny BASIC without expansion, which allowed small, simple programs, and if you bought the Challenger 65V 4K model you got a built-in video terminal so you didn't need a teletype. The top-of-the-line Challenger computer cost $675. If you ordered a memory board with the computer, for $139 you received a 16K board with 4K on board. You were limited to 3 of these because it was a big bargain. OSI even had 16K memory boards, which were almost unheard of in those days! If you ordered 12K or larger, you got the full sized Extended BASIC free!

Far in advance of its time, OSI had a floppy disk for the Challengers. It was a huge bargain: $990 for a single drive, or $1,440 for two. There was a catch, however. Mike didn't wait until he had developed a full disk operating system. He immediately sold his floppy disks with only a preliminary DOS, without a directory! You had to keep track of what was

On the third page of the October 1979 *Byte* 8-page insert was the C4P system with its optional accesseories of a home color TV, joy sticks, AC-remote console and two modules, wireless smoke detector and window detector, modem, printer, and wireless remote security console—obviously, it was meant to be a *real* home computer.

on the tracks by listing it on a piece of paper, but for less than $1,000 who cared about a simple thing like that?

Anyway, Mike would have his DOS "real soon now." OIS owners might not have a directory, but they did have faith in Mike. He was a prolific designer, and when he got an idea he would not wait until the next revision of the board to put it into effect. No, Mike would make the changes on the drawings in pencil, and the very next board made had the new design. His schematics and drawings often looked like chickens had walked over them, and when you had a problem with a board and wanted to trouble shoot, it was wise to check with the factory to find out exactly what modifications had been made to your board.

Mike Cheiky was a pioneer in the use of multiple processors coexisting in the same system. The Challenger 3 had a 6502, a 6800, and a Z-80, all on the same CPU Board. At first there was only software for the 6502. If you wanted to use one of the other microprocessors, you were on your own. Later, this capability provided the ability to run CP/M as well as the OSI operating system OS 65.

This flexibility of the OSI design was also the reason the Challengers were one of the first computers to have a multi-user system and a multi-user operating system, OS 65/U, to go with it.

Not only was Mike Cheiky one of the first to design a floppy disk system for his computers, he was the first to add a Winchester hard disk to a personal computer. The Okidata Company had a 14-inch 84 Mbyte hard disk drive, which Mike interfaced to his Challenger personal computer at a time when most PC were using cassettes to store data! For this reason, OSI got a head start in selling to businesses, and he made some large machines to cater to this market segment.

The one problem that Mike never solved was the inability to add large amounts of memory to his computers. This was not considered too much of a drawback at a time when 64K was considered the absolute limit to RAM memory. Because of this lack of RAM, the disk systems had to do a very large number of disk accesses to load and store portions for the program and data.

The business end of OSI was always quite haphazard.

Delivery dates were long and often missed. Development time for new software was very long and seemed to lack priority in OSI. The dealers were quite fed up, and in 1978 OSI called a meeting at the plant. We went to Ohio, as did dealers from all over the world. Mike Cheiky and his company described their plans to expand into business systems, and the dealers presented all their gripes and problems. As a result, a cooperative software development project was set up, funded by the dealers. Its aim was to develop business application software for use by the dealers who subscribed to the project. Our store did not join because we were mainly devoting our efforts to the Alpha Micro Time Sharing computer as a business system. However, we continued to sell OSI computers to those who wanted them.

If you asked me in 1977 which companies would last into the next decade, I would have never picked OSI. As a company they were badly

This is only part of the extensive line of personal computers that Ohio Scientific made in the late 1970s.

organized and almost impossible to do business with. They were undercapitalized and very slow to deliver ordered equipment. This lost them a lot of the business they could have obtained because of their technical ability.

In 1987 OSI attracted investment capital, and went into both the business computer field and into the very low end of the business. For a long time it seemed that the thing they did best was to advertise and sell equipment. The low-priced personal computers never lived up to the promised performance unless the user learned a lot about the machines. They never could compete with TRS-80, or Apple, or Atari, although OSI low-priced models sold for less and had more features. The main problem was lack of software support. OSI locked out third party software developers, who then turned to Apple and TRS-80 and wrote no software for OSI machines.

In OSI's quest for additional sales, they established a quota which dealers had to meet to keep their dealership. Our store did not sell too many OSI computers, and we refused to sell the cheap models after we found out that we could not get repair parts. We gave full credit of the price toward an Apple because we could not repair broken machines. As a result, we gave up our OSI dealership, and our former landlord at Polk's Hobby Store picked it up.

At the peak of OSI's popularity, they were bought out by MaCom, a large communications firm who wanted to get into the PC industry. The first thing they did was to get rid of Mike Cheiky and stop the low-cost hobby end of the business.

Mike and Charity Cheiky started Santa Barbara Research Company to build super office computer systems.

MaCom looked like they were successful in turning OSI into a business computer company, but the competition was too rough so they sold OSI. The buyer went bankrupt and the company was put up for sale. A company named Isatron purchased the name, but not the company. For a while they built 68000 Unix computers and a few older designs using the OSI operating system OS 65U. The name OSI was used for this line of business computers.

9 THE SAGA OF PROCESSOR TECHNOLOGY AND SOL

The defects of the original Altair 8800 computer helped create the supporting industry. Even after the purchaser laboriously soldered together all its parts and managed to get it working, the original Altair 8800 computer was little more than a box full of promises. It consisted of a front panel full of little switches and lights, and a metal cabinet containing a power supply. The entire computer portion was one CPU circuit board with the microprocessor chip and a memory of only 256 bytes (expandable to 1,024 bytes).

To Gary Ingram and Bob Marsh, a couple of friends from Berkeley, California, the Altair's faults were seen as their opportunity. Marsh, a member of the Homebrew Computer Club, listened to complaints at each of the club meetings and determined that one of the major problems with the Altair was the small amount of memory provided with the computer kit. The Altair's design did provide for plugging in additional memory boards, and both 1K and 2K Static Memory Boards and a 4K Dynamic Memory Board were offered by MITS. However, the 4K memory board was considered unreliable.

Marsh and Ingram decided to form a company, Processor Technology Incorporated, to produce improvements for the Altair.

The two partners were completely different. Marsh, a small good-looking man with dark hair and a thick mustache,

had an outgoing personality and a good sense of humor. Gary Ingram was a long haired, reclusive ascetic. He seldom had anything to say to outsiders. Both were deeply involved with electronics. Though Marsh had dropped out of engineering school, he worked on the fringes of the industry. Ingram was employed as an engineer. The partners developed a wish-list of improved boards for the Altair.

Describing their ideas as already-completed products, they composed a magazine ad and a hand-out flier, hoping to generate funds for their enterprise. This was a common practice in those days. People read ads and would send money to buy "vaporware," products that were announced and sounded good, but would only be available "real soon now." In the case of Processor Technology, their ads reaped a harvest of checks, and the partners were able to rent Lee Felsenstien's garage in Berkeley, where they went to work to make the ads come true.

The first product Bob Marsh worked on was a 4K (4,096 bytes) static memory board. He knew 4K was needed to run the smallest version of Altair Basic, yet the most glaring defect in the Altair was the lack of reliable 4K RAM memory.

There are two kinds of memory chips used in constructing computer memories. The Read Only Memory (ROM) chip, once programmed, retains its information even though you turn off the power. However, since its memory can not easily be re-programmed, the ROM chip is only used for information that does not change.

Random Access Memory (RAM), the second type of memory chip, can easily be re-programmed, and so it is the working memory of the computer. There are two types of RAM memory chips. The most common, Dynamic Memory (DRAM) needs periodically to be given a pulse of electricity (refresh) to keep its memory alive. The alternate choice is Static Memory (SRAM), which consumes more power, but will retain its information without refresh as long as it is connected to a power source. Both DRAM and SRAM will lose information once the power is turned off.

MITS had intended to make memory expansion its first priority, but the expensive 4K dynamic memory board it created did not work well. The Altair board obtained its

essential refresh pulse from the 8080 microprocessor chip by a process called "cycle stealing." The problem with this technique is that sometimes the computer chip is off doing something at a time when the memory needs to be refreshed. If this happens, the memory "forgets," and data is completely lost! To make "cycle stealing" work at all, precise timing is required.

Timing problems in the Altair 4K board were what made it defective. Bob Marsh designed the very reliable Processor Technology 4KRA Memory using static memory (SRAM) chips. It had 4,096 (4K) bytes of memory, but if you didn't need that huge amount you could buy it with only 2K, and later add the rest. The 4KRA was priced at $218 in kit form, or $280 assembled, while the defective MITS board cost $264 in kit form and $380 assembled. When 8080 computer users read the ads for the 4KRA, they flooded Processor Technology with paid-in-advance orders.

The instant success of Processor Technology's 4KRA was the catalyst that launched the company into business. Bob Marsh and Gary Ingram moved from their garage workshop into a much larger industrial facility in Emeryville, California, and were joined by Steve Dompier and Gordon French of the Homebrew Computer Club. They hired Lee Felsenstein, their former landlord, as a design consultant. The company started producing a steady stream of new products that worked with the Altair and other computers of the same basic design.

Processor Tech's Altair Mother Board

After the company's great success with the 4KRA memory, Marsh turned his attention to another acute but much simpler problem with the Altair. It badly needed a better motherboard, and MITS was not going to provide one. When you bought the computer kit, MITS only supplied a four-slot motherboard and one connector for each plug-in board ordered. If you originally bought the kit with only the Central Processing Unit (CPU) card, you only had one installed connector. When you wanted to put in a memory board, you had to disassemble the computer to solder in the 100 pins for the next connector. Most owners only went through that once. They got smart and soldered in all the remaining connectors at one time. If you

wanted to expand your computer with additional plug-in boards, you had to solder in additional four-slot motherboards and connectors.

You really had to be a dedicated hobbyist to go though that kind of torture. Processor Technology designed an 18-slot motherboard and sold it for only $35. You could add Altair's full compliment of 18 connectors (at a cost of $15 each) all at one time. Word of this improvement quickly spread among Altair owners, and they bought all the boards Processor Technology could make.

The 2K ROM Board

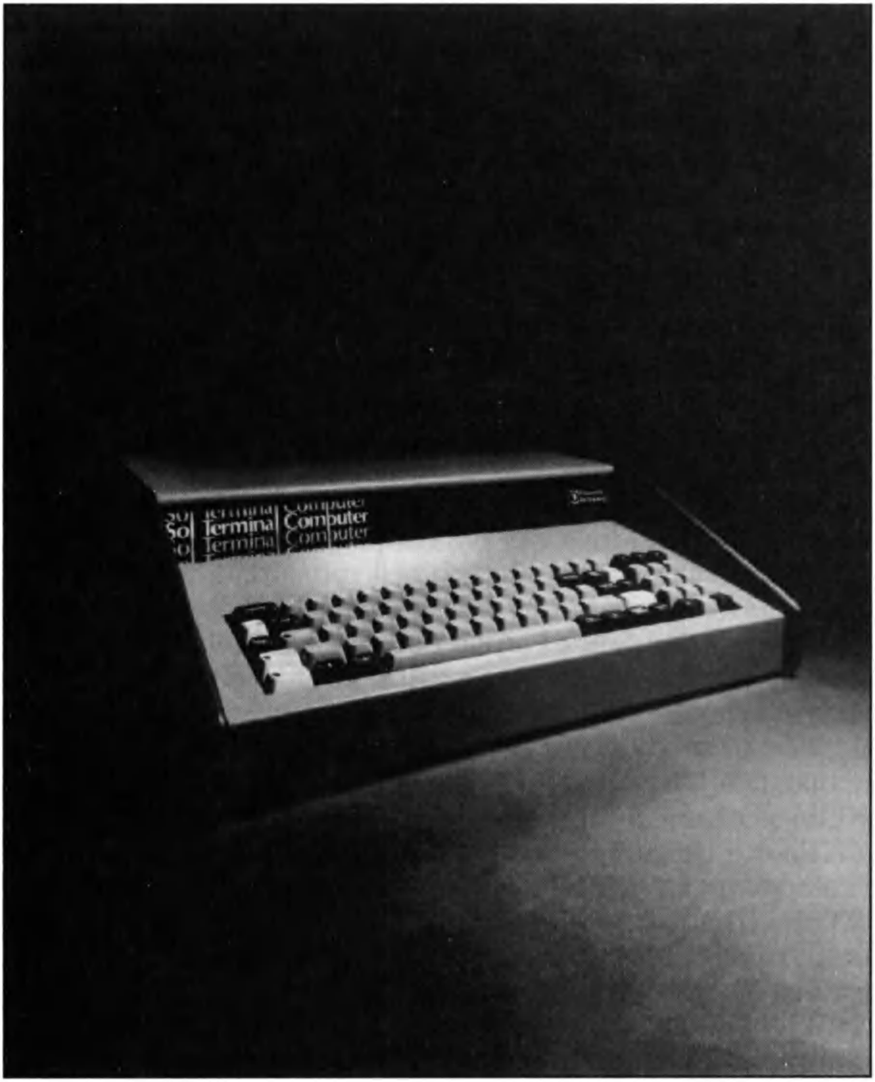
Processor Technology offered another product they thought was needed for the Altair or Imsai, a 2K ROM board. Loaded with programmed Electrically Programmed read-only Memory (EPROM) chips, this board allowed the user to start his computer without flipping countless front panel switches. The board was not much of a success. It came without the EPROMS, which were difficult to buy and once bought were beyond the programming ability of most computer hobbyists. In addition, the computer hobbyists *liked* to flip the front panel switches. It was part of the mystique of the computer they were unwilling to share with the casual user.

Almost Free Software

Processor Technology proposed to supply its customers with "almost free software." For only $15, it made Software Package #1 available, containing an assembler, a text editor, and the system executive programs. The utility programs in this package made it possible for the hobbyists to develop applications using the additional memory now available. Processor Tech also promised a low cost version of BASIC, a promise that caused them a lot of trouble and was not kept for about a year.

Computer Mart Becomes a Dealer

Back in New York, I became the Storekeeper (the title I gave myself) of The Computer Mart of New York. Noticing a small ad for Processor Technology in *Popular Electronics,* I



Processor Technology's Sol Computer.

asked Les Solomon, Technical Director of the magazine, about the company. Les knew all the members of Processor Technology and recommended I do business with them. He confided to me that, in addition to the products advertised, new devices were being developed that he said would "blow you away."

When I expressed interest in becoming a Processor Tech-

nology dealer, Les called Bob Marsh from my store and arranged for my dealership. As with IMSAI, my main supplier, the financial arrangements were simple. My order was paid for with cash-in-advance, so the company could use my money to buy the parts to fill the order. I got most of the advanced cash from customers. They were so anxious to get the boards, they were willing to pay at least 2/3 of the price up front just to be placed on my delivery list. Of course, if the wait was too long, I had to refund the money. But often, no matter how long the wait, customers chose to leave their deposits rather than take a chance on being dropped from the list.

The best part of becoming a Processor Technology dealer was that it greatly expanded my customer base. Ed Roberts, head of MITS, would not let his dealers sell any products that competed with Altair. My philosophy was directly opposite. My store was the very first to sell more than one brand of computer, and my policy was to carry all kinds of computers and accessories. Since I could not sell Altairs, the people who owned them never had occasion to come into my store. However, with the Processor Technology line Altair owners flocked in to shop for the products they read about in the magazines. They bought Processor Tech boards from me as well as chips, connectors, software, books, and magazines.

Two sorely-needed new Processor Tech products revealed to me by Les Solomon were an input/output board and a Video Display Module. Until this time the difficult job of getting information into, or out of, the microcomputers required separate parallel and serial interface boards.

At that time, the main input/output device used with big computers, minicomputers, and microcomputers was the Teletype®. This wonderful but noisy machine was both a keyboard-input terminal and an output printer. In addition, many Teletype® models included a paper tape punch which could be used as the computer's memory storage.

Connected to a Teletype®, your computer could "dump" the program or data in its memory by punching a pattern of holes into a paper tape. These paper punches could also duplicate their tapes. As many copies as required could be made, and the paper tape could then be rolled or folded up

and stored in a drawer. In the early days, punched paper tapes became the principal method of distributing software, mainly because there was no standard for cassette tape.

For the microcomputer user, the main problem with the Teletype® was its cost. The Teletype Corporation sold only to large companies and then only on a yearly contract. New machines cost about $1,800 (three times as much as the microcomputers) and were very hard to get. On the re-sale (gray) market, "used" machines (really, new ones) were sold for as much as $2,500 and re-built ones for about $1,200. Computer hobbyists tried to find old, obsolete models to repair and put back into service, but they were scarce.

Even if you had a Teletype®, you still needed a serial interface board to connect it to the computer. The 3P+S Interface board from Processor Technology had three parallel ports (3P) for connection of various devices such as keyboards, printers, and plotting boards. The 3P+S board also had a serial port (+S) for connection of any kind of Teletype®, no matter how old it was. This was possible because the 3P+S had hundreds of options, which you could select by installing various jumper wire combinations. No matter what printers, terminals or other I/O devices you added in the future, you would never outgrow the 3P+S.

In an effort to provide machines for Altair users, MITS made a deal with Teletype Corporation. For $1,500, MITS sold a brand new Teletype® machine that would only work with their Altair I/O board. Within a few months, the hardware hackers found a way to interface the Altair/ Teletype® machine with a 3P+S board. The information quickly became available to all users through the magazines and computer clubs, rapid conduits for all new breakthrough information. Selling for only $125 in kit form, the 3P+S became Processor Technology's best seller.

The VDM-1 Video Display Module

In 1975, using a video terminal instead of a printing terminal for computers was a relatively new idea. The video terminals were sometimes called "glass teletypes." They were expensive. The price of a video terminal was many times the cost of a personal computer, so they were only used

for large computers

In September of 1973, two years before the Altair appeared, *Radio Electronics Magazine* had published an article, "The TV Typewriter" by Don Lancaster, describing how to build a crude video device. This device used a TV screen to display the characters which had been typed on a keyboard. Lancaster expanded the article into *The TV Typewriter Cookbook,* a book written to help hobbyists build their own video terminals. The South West Technical Products CT-1024 Terminal kit, described in the previous chapter, was very difficult to connect to an Altair or IMSAI.

Before working for Processor Technology, Lee Felsenstein had been attempting to build a video-operated "Tom Swift Terminal." Therefore, Marsh and Ingram chose Lee as the person to build the plug-in video terminal board needed by the Altair.

The Processor Technology VDM-1, as it was called, was advertised for sale in the first issue of *Byte* in September of 1975. Delivery was promised 3 weeks after receipt of order. Processor Technology, like all the early computer manufacturers, underestimated the development time required for a proposed product. The VDM-1 was not actually available until the fall of 1976, and even then delivery might take up to 60 days after order.

When the VDM-1 finally was delivered, it did everything promised. You could connect a keyboard to the computer through the 3P+S Board, plug-in your VDM-1, connect it to a video monitor, and your computer became its own video terminal. The VDM-1 also ran one of the first action video games. Developed by Steve Dompier, *Target* shot arrows at targets moving across the screen.

The video board was almost too good to be true, with only a few minor faults. A real video display terminal usually had 80 characters displayed across the screen and could show 24 lines of text. The VDM could display only 64 characters on each line, and there were only 16 lines of text. A real video display terminal was made, with special cathode ray tubes (CRT's) and video circuits designed for that specific purpose. Such CRTs were not available for use with the VDM-1. You had to use either video monitors designed for closed circuit

television, or converted TV sets. In TV, the picture is "painted" on the face of the tube by a stream of electrons. It "paints" (scans) one line at a time. At the end of the line, the electron stream is blanked out and is returned to the next line. Then it scans across the tube again. This TV scan rate, which permitted only time enough to display 64 characters by 16 lines, was used as the basis for the VDM-1 design. Since typing margins are usually set at least 5 to 10 characters from the edge of the paper, 64 characters proved to be satisfactory for word processing. The VDM-1 was such a wonderful board that users forgot its shortcomings. It became another best seller for Processor Technology.

The Time of The SOL

The VDM-1 completed the full line of expansion boards for the Altair/Imsai computers. Processor Technology now proposed to write an article describing how to build a video terminal for the Altair. *Popular Electronics Magazine* agreed to publish the article and show the completed terminal on the cover, provided it was ready for photography within 30 days. Bob Marsh hoped a cover story would assure immediate success for the new product, so he challenged Lee Felsenstein to undertake the task. Using the same circuits Processor Tech perfected for their earlier boards, Lee set to work to meet the deadline. His final design went further than the requirements for a video terminal. He developed a complete new computer. This was a different kind of a computer, one designed not for hobbyists and hackers but for business people who needed useful applications. This was to be a machine not relegated to a workroom or the basement, but a computer that could proudly claim a place in a living room or a private office. The new machine would look somewhat like a modern blue typewriter with handsome walnut side panels and an excellent keyboard.

A friend of Bob Marsh could supply the walnut side panels for the case, if the computer was designed low enough to fit them. The height problem was solved by mounting the expansion boards horizontally rather than vertically. With only room in the case for five boards, most of the computer functions, including the CPU, video, I/O ports, and cassette

interface, were mounted on a single large PC board positioned on the bottom of the computer.

Felsenstein's design included a completely new idea, the "personality module." This was a ROM containing various types of system software which changed the capability of the computer. It could have a standard operating system, an intelligent text editing system, or a special operating system designed for a specific job. To effect a change in personality, all you had to do was plug-in the appropriate module.

The stripped-down terminal version Lee designed for the magazine article had a personality module, but only had limited RAM memory. It was still more intelligent than most "glass teletypes," so it was called The SOL Intelligent Terminal.

The full version was to come in two styles. The less expensive one had a simple keyboard and only one slot for expansion. It was called The SOL-10, and very few were ever built. The second model was a complete computer with an excellent keyboard and a card cage with five slots. It was called The SOL-20, and provided enough memory for general computer applications.

When the prototype was complete, the Processor Technology crew headed for New York City to demonstrate it to Les Solomon. The machine had been named The SOL, in his honor.

When Bob Marsh revealed the name to me, I called Les and joked, "They're naming the new machine after you—The LES Intelligent Terminal!"

Solomon was flattered by the honor in spite of the fact that when Bob Marsh and Lee Felsenstein arrived with the computer, it did not work. It took two days of intensive troubleshooting in Les's basement workshop to bring the SOL to life.

The article in *Popular Electronics* offered a kit version at a very low price and free schematics to all who asked. Processor Technology, deluged with orders, took almost a year to fill them. The SOL-20, the full working computer, was introduced at the *Personal Computing* '76 show in Atlantic City. PC '76 was the first big computer show ever held, and SOL-20 was the hit of the show.

My store was selected to be one of the first dealerships to

An ad for the Sol from the Sept-Oct issue of *Creative Computing*.

get the SOL. We were a large, well-established New York City store, and many influential business and financial people were our customers. With an eye to attracting additional financing for future growth, Processor Technology wanted the SOL-20 to make a good impression. The Altair and Imsai computers had mainly been sold as kits. The SOL was the first personal computer to only be sold as a factory-built computer. There was one problem, however. The computers I received were "dead on arrival."

I immediately called the factory for repair instructions.

"Can you wait a few days?" Bob Marsh asked me.

"Sure," I answered. "What's going to happen? Magic?"

Three days later, Lee Felsenstein walked into the Computer Mart and asked, "Where are those dead computers?"

A fully operative SOL was important enough to put the designer on a plane for the first service call. From that time on, all computers were carefully tested before shipment. We never again received a SOL that did not work right out of the box. In fact, the SOL became known as the most reliable machine on the market. By 1977, SOL was the dominant personal computer in the industry and was the principal

product in my store.

In the spring of 1977, Processor Technology called a "mandatory" dealer's meeting at its headquarters in Emeryville, and I traveled to San Francisco to attend. It turned out to be an important meeting for me as well as for Processor Technology. Here, I met other dealers from all over the United States and made contacts that proved to be of great advantage for future business. John French, owner of the Computer Mart of Los Angeles, was a telephone acquaintance, but after this meeting we became close friends and business associates.

While at the meeting, I received several urgent calls from Steve Jobs asking me to meet him in his garage "factory." He was so insistent that I took time out to meet him and Steve Wozniak. What happened there is the subject of another chapter, but two years from that meeting Apple Computer had replaced Processor Technology as leaders of the industry.

At the Processor Technology meeting, Bob Marsh described the company's plans to introduce the Diablo disk system. This disk system, which was to sell for $1,200, was exactly what the dealers needed. The SOL computer was selling to business people more than home users, and cassettes were not appropriate for storing business programs and data. Gary Ingram made one of his rare appearances, and demonstrated the disk system and the PTDOS operating system. The dealers were also promised larger memory boards and a new color video board.

Business was so good that Processor Technology announced it would no longer require cash in advance. Qualified dealers could now place orders and pay COD. Thirty-day credit terms were promised in the near future. Dealers had to submit an order every three months, and for larger orders there would be an increasing scale of discounts. We all left Emeryville with a feeling of confidence that both Processor Technology and our dealerships were well on the road to legitimacy, leaving behind the "hobbyists" stigma and emerging as a real computer business.

When I returned to New York with the news of the disk system, several of my customers started developing business software for the SOL. These included a lawyer's time accounting system, a church collection accounting system, and an

income tax preparation program.

But the picture wasn't quite as rosy as it seemed for Processor Technology. The Diablo Company, whose main business was daisy wheel printers, was purchased by Xerox Corporation, and the development of Diablo's floppy disk drives was stopped. Most of Processor Technology's work on the floppy disk drive system was lost. They were back to square one using cassette tape storage.

Marsh and Ingram's answer to this problem was to adopt a new disk drive just coming on the market, the Persci 270. A new and untried device, it drove two 8-inch floppy disks with one motor. The basic idea was to obtain twice the disk storage at less than the price of two drives. The new Processor Technology floppy disk system, called Helios, consisted of a cabinet containing the Persci 270 (with two drives in one assembly), the power supply and cables. The PTDOS disk operating system was included. The cost, $1,895, was later raised to $2,300.

For a while Processor Technology continued to grow, and the dealers prospered. Then Radio Shack came out with its TRS-80 Model I at half the price of the SOL. They eventually developed a disk drive and the TRSDOS operating system. The Apple II appeared and quickly became very popular. The Apple II sold for much less than the SOL, could do graphics in color, and had an ever growing library of software. Its drawbacks were a 40-column screen and the lack of upper/lower case characters. In spite of these drawbacks, when Steve Wozniak developed an inexpensive and reliable floppy disk drive for the Apple II, it soon outsold the SOL.

At Processor Technology, the partners were mesmerized by the success of their company. They became aloof, less available to the dealers, and appeared not to be interested in their problems. Lee Felsenstein urged them to improve their products, but, except for larger memory boards, no new products were under development, and no attempt was made to upgrade the SOL to keep it ahead of its rivals. The promised color video board was never delivered and neither was the promised improved BASIC. Though Chuck Grant and Mark Greenberg, owners of North Star Computers, had been under contract to Processor Technology to develop a version

of BASIC for the SOL, North Star, claiming that their agreement was non-exclusive, sold it to other computer manufacturers. Processor Technology was under the impression that the BASIC was exclusively theirs, sued, and lost the case after a long litigation that hurt both companies.

In spite of the growing problems, Processor Technology moved south to a much larger plant in Pleasanton, California. There, in big offices with windows overlooking the countryside, the partners became even more distant from the heart of the industry and their dealers. They talked more to outside financiers about investors and the possibility of going public, and less to the people who sold and used the SOL.

Meanwhile, North Star developed a new, low-cost, mini-floppy disk drive system that would work with the SOL. Coming with its own operating system, the disk cost less than half the price of the Helios.

Back in New York, Larry Alcoff, a young man interested in personal computers, had undertaken to make the CP/M operating system (now an industry standard) run on the new inexpensive North Star disk drives.

When he started, Larry did not realize he had undertaken a tremendous task. He was a wealthy young man who hung out first at my computer store, and then at Bob Radcliffe's Hoboken Computer Works. Radcliffe, a former Bell Labs engineer, urged Larry to try this difficult job as a way of learning about programming and computer hardware at the same time. As Larry progressed with Bob's help, it became apparent that the job would succeed.

To sell the product, Larry first sold "program patches" to CP/M owners that allowed them to run their CP/M software on the North Star 5 1/2" drives. Then, at the suggestion of Tony Gold, who ran the CP/M Users Group, Tony and Larry formed a business called Lifeboat Associates because they were "all in the same boat." The partners licensed CP/M from Digital Research Incorporated and produced a new North Star 5 ½" Drive version of CP/M. If Processor Technology had adopted the North Star floppy disk system, it might have avoided additional trouble. However, because of the past legal problems, the partners refused to even consider it. They kept trying to sell the Helios disk system to their dealers.

Like many other personal computer companies, Processor Technology looked to the business market for its salvation, and didn't find it. The above portion of an ad appeared in the Summer 1979 *onComputing*.

Problems with Helios started to surface almost at once. Although much faster than most of the other 8-inch disk drives being sold, the Persci 270 was very sensitive, difficult to keep in alignment, and if moved, might lose alignment and stop working. Unfortunately, these problems only surfaced after Processor Technology spent thousands on development and manufacture, and had shipped the Helios to several dealers. It was too late to switch to another drive.

In addition, many people, including the dealers, urged Marsh and Ingram to abandon PTDOS, their proprietary operating system, and adopt CP/M. The partners refused to listen, certain that their system would be much better.

When their pleas and recommendations went unheeded,

the dealers became less and less interested in the Helios. They could sell the North Star disk drives and ignore the undependable, expensive Helios. For the next year most of the dealers sold SOL computers with North Star disk drives and CP/M from Lifeboat. This made business applications possible. If you included a daisy wheel printer and either WordStar or Michael Shrayer's Electric Pencil, the SOL became an efficient word processing system that only cost $3,500. In those days, an equivalent dedicated word processing system cost $10,000. Soon other disk drive systems made by George Morrow, Micromation and Micropolis came on the market and could also be used with the SOL and CP/M.

Thus, SOL dealers who ignored Processor Tech's Helios disk and its oddball software prospered, but dealers who sold the Helios found themselves in trouble because of constant failures. In my case, one of the few Helios I sold resulted in a lawsuit by my customer against Processor Technology, one of many such cases throughout the country. Until suit was brought, Helios customers could not even get the principals at Processor Tech to discuss the problem. Marsh and Ingram

A news release in September 1977 proudly touted the new 36,000-square-foot Processor Technology headquarters. Here the company became isolated from its dealers and customers..

would listen to no one.

As if the problems with the Helios drives were not bad enough, Processor Technology finally came out with a new line of dynamic 32K and 64K memory boards. These boards used new dynamic memory chips rather than the static memory used in the original Processor Technology memory boards. The required refresh cycles for the dynamic memory chips were generated on the board itself. This procedure supposedly made them "safe" from the problems associated with the original "cycle stealing" dynamic memory boards. But all at once, all over the country, these new memory boards began to fail. At first, Processor Tech replaced the defective boards, but the problem soon became overwhelming. When dealers sent in defective memory boards for replacement, none were returned.

Relationships with the dealers became more strained. It became harder and harder to communicate problems to the partners, yet people on the lower level were not given the power to make decisions.

To keep my dealership, Processor Technology required that I send in an order every three months, but, since I (and other dealers) were selling more and more Apple II's and less SOLs, our inventory of SOL boards and computers grew until it reached almost $100,000. I became very concerned and tried to talk to the company about my problem. I knew I couldn't afford to buy any more, and I wanted to run a sale to convert this excess inventory into much-needed cash. When the ordering period came, I declined to order anything, and Processor Tech pulled my dealership. In answer to this, I prepared an ad for *Byte* and several other magazines saying "SO LONG SOL" and announcing a clearance sale at 50% off. When Processor Technology heard about it, the partners called and begged me to take back my dealership.

Gary Ingram himself said, "It all was a terrible mistake. Please don't drop the line."

They would help me reduce my inventory by selling it to other dealers. Because of our close relationship in the past, I agreed and canceled the ads. But my problems were only typical of the trouble at Processor Technology. The accumulated mistakes and the unresolved problems, compounded

by the inaccessibility of the owners, proved to be overwhelming. On May 14th, 1979, Processor Technology closed its doors forever. They did not declare bankruptcy, they just closed. I was stuck with almost $100,000 worth of inventory that I had to liquidate.

Lee Felsenstein went on to design the Osborne 1 Computer, Bob Marsh went into business building mini floppy disk drives for the Osborne Computers, and Gary Ingram completely disappeared from the industry. But the thousands of SOL computers did not disappear; they survived and were used for years by their owners until they could not be maintained any longer.

10

the digital group

One of the most original manufacturers of microcomputer equipment was the digital group of Denver (never to be confused with Digital Equipment Corp!) This group of hobbyists and designers, led by Dr. Robert Suding, could be considered more of a cult than a company because they adhered to a set of beliefs regarding computers and microprocessors that was generally at odds with the rest of the industry.

The Digital Group (or, as they preferred, "the digital group") believed that the industry would constantly develop new microprocessors and that the computer hobbyist should have a personal computer system that allowed him to change from one processor to another without losing the investment in the total system. They realized that the major part of the investment in computer equipment was spent on memory, interfaces, software, and peripherals. Therefore, they reasoned that if you purchase a CPU that quickly becomes obsolete (as they all do,) any investment in memory and peripherals specifically designed only for that CPU will be made totally obsolete. The digital group systems were designed to be independent of the manufacturer's chip design. Complete system compatibility was maintained at the CPU card level. All memory, I/O, and peripherals were completely independent of the CPU selected. They provided architectures from four CPU manufacturers: Zilog/Mostek Z-80, Inter

8080, Motorola 6800, and MOS Technology 6502.

With the digital group system, you could change from a Z-80 to a 6800 by literally un-plugging the Z-80 board and plugging in a 6800 board. Once you had done so, all you had to do was power-up and read-in the 6800 operating system from a cassette, and you had a 6800 system. The same was true of the 6502 board. This was the basic idea behind the digital group designs, and it was very attractive, mainly to hobbyists.

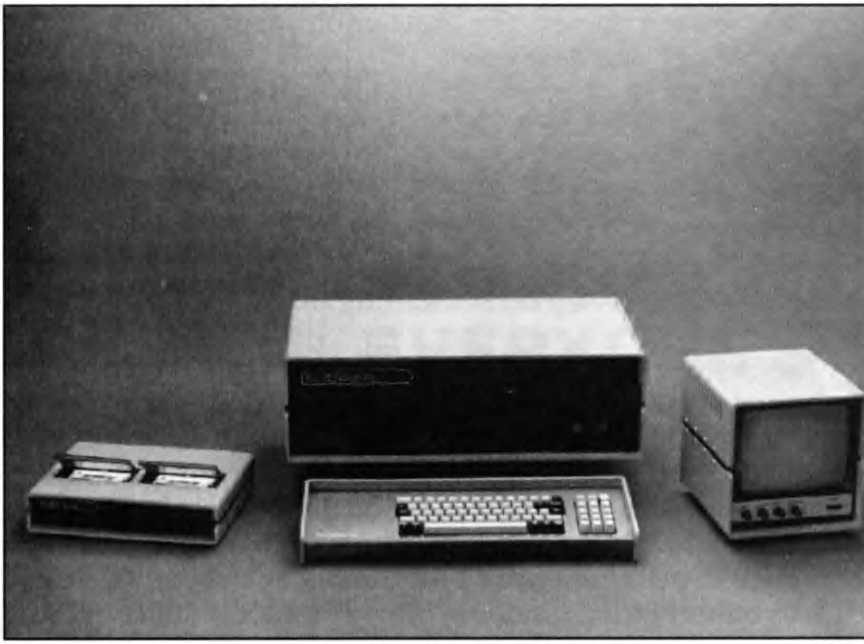
In addition to the interchangeability of processors, the digital group system had quite a few other features that were far in advance of the other early microcomputers. It did not require a front panel with switches and lights since all the start-up software was contained in a ROM. It used a combination video and cassette interface board at a time when other computers still relied upon teletypes and provided a cassette-based operating system, which could use a standard unmodified cassette recorder to operate at 110 characters per second where other systems operated at 30 characters per second. It had a crystal-controlled interface that did not require constant adjustment and was extremely reliable. The video portion displayed 16 lines by 32 characters of a 7 by 9 character matrix and included math symbols, special symbols, and even the Greek alphabet.

The digital group system used reliable 8K static memory boards that would work with any of the CPU boards selected.

In addition, the digital group system was available to users as either a four-board system or any other sized system according to the owner's requirements. Since the system was designed for hobbyists, the highest level of interchangeability was provided.

Given all these advantages, the reader may wonder why the digital group was not more successful as a computer manufacturer. Well, they were completely hobbyist-oriented, and while they had dealers they never supplied equipment on a steady basis. You really had to want a digital group system very badly to put up with their erratic shipping habits. They only promised to ship orders in sequence received, and dealers had to wait in line with retail customers.

When a customer came into my store and asked for a



The long-awaited digital group cabinets only came out shortly before they went out of business.

digital group system, I would carefully explain the terms. The customer must completely pay for the system up front. I could not give a delivery date, and most likely the board kits would arrive in haphazard fashion with no order to the supply. It was almost impossible to get an assembled unit, so the customer must have the ability to solder complex printed-circuit boards. In addition, when the computer was completed it would still require complicated tests and adjustments requiring electronic test equipment. I did not have this equipment, but if the customer wanted I would send his assembled computer to my friends at the Personal Computer Company in Frazer, Pennsylvania, who specialized in digital group computers. They assembled these and installed them into a very attractive wooden cabinet which they called a "Personal Computer." As far as I know, they were the first to use this term for a microcomputer, way back in 1975 (not Apple as they often claim.) The reason for the wooden cabinet was partially that digital group did not sell any cabinets for a long time. When they finally designed some

very attractive cabinets for their equipment, it was almost impossible get one delivered.

With all these negative situations, you may wonder why I bothered to become a dealer for this computer cult? (It could hardly be called a company.) Well, it was my principle that Computer Mart of New York would sell all available microcomputers. I also hoped that they would become more business-like. Besides, I did manage to sell most people who asked for digital group on something that would make them happier.

The demise of digital group happened quite a bit before the general disappearance of all 8-bit S-100 companies. There were just not many hobbyists who subscribed to the ideas of the group, and when the pool was used up the company expired. Even dealers who had based their whole business on the system finally had to give up because non-scheduled deliveries drove them out of business.

As you might imagine, anyone who finally succeeded in building and operating a digital group machine became one of an exclusive brotherhood who were one of the loyal group of users. Long after the demise of the company, the user groups carried on, and there were even third-party small manufacturers who made compatible equipment such as communication boards, floppy disk systems, and speech boards. One of these was Aeon Electronics, also of Denver Company, who made equipment well into 1983. Finally, even the user groups gave up, and the entire concept died.

11 TRS-80, ALMOST EVERYONE'S COMPUTER

In the spring of 1977, I received a phone call from Ben Rosen, who at that time was a market analyst for Morgan Stanley. He was just about the only stock market analyst specializing in the infant personal computer industry and one of the industry experts. Ben, who later became the Chairman of both Compaq and Lotus, had already organized the first of his famous industry seminars, and he had invited me on a panel as a retailer. This call, however, was to tell me that I was about to receive a visit from an important person, if I had time to see and talk with him today. Ben went on to tell me that my visitor would be Charles Tandy, who owned the Radio Shack chain of some 7,000 stores. He had only that day, and he wanted to visit a successful computer store.

Mr. Tandy arrived shortly after lunch and introduced himself.

"Call me Charles," he said as I conducted him through my operation.

We started in the basement where we repaired computers, built many of them into systems, and had our stock room. Then to the selling floor, where he seemed most interested in the Apple II and the SOL. Charles was a man who could put anyone at ease, even if they knew how important a person he was. He had the knack of asking the most direct and revealing questions in a way that aroused no resentment. I really enjoyed talking with him, flattered that this powerful busi-

nessman would seek me out for advice. At the end of the day, he told me that he had visited other computer stores and in general classified them into two categories: first, stores run by computer hobbyists where a neophyte would be ignored, or snowed. The second type of store was run by ex-used car salesmen who were masters of the hard sell. They tried to completely snow the average prospective buyer. He said my store did not fit into either category (for which I was grateful,) but seemed to meet the customer at whatever level they were at. I told Charles that most of my salespeople were recruited from the hobbyist ranks, but that I had trained them somewhat in the art of retail selling.

We talked all afternoon, and at the end of the day he asked what I was doing that weekend, and would I consider going back with him to his headquarters in Fort Worth. It was common gossip in the industry that Radio Shack was going to be selling computers very soon, but nobody knew what kind they would be selling. Now it seemed that I was being invited to get an advance look. Of course I told Charles I would love to go with him.

The next morning was Friday, and I met the Tandy party in their suite at the Hotel Carlisle on Park Avenue for breakfast. After breakfast, we piled into a limo for a trip to the airport, but first we made a stop at a nearby shop where they sold novelty telephones. Charles bought a few as gifts for his friends back in Texas. Later I was told that he bought the store because they carried the most unusual phones. Phones packed aboard, we drove out to Teterbro Airport in New Jersey and boarded the Tandy corporate jet for the flight to Fort Worth.

All this was new and exciting to me. I had never flown in a corporate jet, and I had never been to Texas, either. Landing in Fort Worth, we all drove to a local barbecue which was Charles favorite, and then straight to the Tandy plant. There, Charles introduced me to most of his executives and told me they were developing a new type of computer for sale in their stores. He said that they had investigated all of the machines being offered for sale and had come to the conclusion that they were all too complicated and too expensive for the average person. They had therefore designed a completely

Photo courtesy Radio Shack

Radio Shack's complete TRS-80 Microcomputer System, consisting of a 53-key keyboard and microcomputer plus regulated power supply, computer-controlled data cassette recorder, and 12" video monitor. It was, the company advertised, suitable for business, educational and home applications. It was available exclusively from Radio Shack stores and dealers, nationwide, from $599.95.

new concept in small computers.

With that, they showed me what seemed to be a keyboard and a 12-inch TV screen, with a wire connecting the two units. The plastic case was colored with a metallic silver gray finish, and the keyboard and front of the TV was a contrasting black. The oversized logo on the front read "RADIO SHACK TRS-80" and "MICRO COMPUTER SYSTEM."

My first comment was, "Where's the computer?"

"It's inside the keyboard case," I was told.

"Right under the keyboard!" I could hardly believe it.

I was used to the Altair and Imsai—even the SWTPC 6800 and the SOL with their brute force power supplies and expandable bus. Even the Apple II, which I considered a masterpiece of compact design, took much more space than

the TRS-80 keyboard unit. Then I noticed the external power supply plugged into the wall. Well, there was one reason for the size.

"We decided to use an external power supply to conserve space and keep the heat out of the computer case.

"Okay," I thought. That made sense.

I really liked the idea that the TRS-80 came with its own TV monitor. In those days video monitors were very hard to get and they were expensive. I had bought a huge order of 9-inch, high quality, security type video monitors to sell with my computers, and I sold them at a very small mark-up if the customer bought a computer.

Radio Shack had provided a 12-inch TV quality video display that was really a television with the radio section removed. This was a smart way to get a larger, reasonably priced video monitor if you had the buying power of Tandy.

"Tell me some more about the computer?" I asked.

"Well," someone answered, "it's a Z-80 based machine with 4K of RAM, and a ROM with the boot-up software and BASIC. Programs and data are loaded through a cassette. The video display has 64 characters and 16 lines and there are graphics characters as well as uppercase letters."

"This is interesting," I thought. "Just like the first Apple I."

"Tell me about the BASIC?" I asked.

"Well, it's out. Level I contained in a ROM. This is an integer-only version with only two character variables. Our Level II will be out shortly and will have enough advanced features for anybody."

By now I was very impressed with the TRS-80, and I fully realized that it was going to be hard competition for anything I sold, except possibly the Apple II. The big question in my mind was, how much would they sell it for?

As if he was reading my mind, Charles asked me, "How much do you think should I sell it for?"

I really had no basis of comparison except possibly the SOL (I had not received an Apple II yet,) and it sold for $1,400 with a video monitor. Well, this machine is a lot simpler, so I should figure about $1,000. However this is Radio Shack so it must be cheaper. I'll say $900.

"Well," I said, "about $900 would be a fair price."

"What would you think about $600?" one of the Tandy people answered.

"If you are going to sell this system with a video display and built-in BASIC for $600, you better build a hell of a lot of them," I returned.

"Stan, just how many do you think would be enough?" one of the Tandy people asked.

"Enough," I said, "would be about 50,000."

"You are out of your mind," answered one of Tandy's staff. "No one has ever built more than 5,000 of the same type of computer, and we are thinking 12,000."

"You have 7,000 stores," I returned. "If you have only one to show and one to sell, that's no way for a big company to do business."

"We don't think all of our stores can sell computers; it's a specialized business."

"True," I answered, "but this computer may change all that."

After this exchange, I sensed a division in the company. Charles and all the people he had brought on board to develop the TRS-80 were convinced that the TRS-80 would be a tremendous success and would change their business. The older electronics people whose thinking was fixed in the audio, radio, and hobby electronics business did not understand the fascination of the computer for even the most conservative business person.

Charles then showed me folders containing cassettes and manuals for all kinds of home and business software. There were accounting programs, home management programs, and educational programs—all to be sold for less than $30.

At this I smiled and said, "Keeping business records on a tape cassette program has not proved very practical. (I was being very kind!) You would be well advised to keep your programs very simple until you get a disk-based system."

They ignored me and changed the subject. "How many of these computers could you sell in your store?"

"I would start with 10 per week and end up selling 40 or 50 a week," I replied.

They obviously did not believe me, but they didn't challenge my statements.

The meeting broke up at that point, and I was taken to a hotel to freshen up for some Texas hospitality later that evening. The next day was Saturday, and about 9:30 I received a phone call that Mr. Tandy was tied up, and that I should have my breakfast. He would pick me up later.

About 10:30, Charles picked me up at the hotel and took me to the yet uncompleted Tandy Center. He showed me the building and parking lot with its subway into the center. He told me that it would become a center of life in Fort Worth, and he wanted it to be his contribution to the city he loved.

Then Charles told me how he had started in business making leather hobby kits and selling them in his craft stores. How he had bought the failing Radio Shack company, which was a retail electronics distributor that had evolved from ham radio equipment. He had built Radio Shack into the world's largest electronic retailer and one of the largest distributors in the United States. He believed that the personal computer industry was going to become very important in the near future. He also said that most of the companies then in business would fall within a year of two. The reason, he said, was because they were so disorganized and had no idea how to manufacture and market their products. I was very impressed with Charles' statements because I had staked my future on the industry, and I had the same feelings about some of the companies I did business with.

After we left the construction of Tandy Center, we went to the temporary offices of the corporation where we resumed our meeting. There I was told that Charles wanted to buy my store and hire me to train managers for his computer stores. The purchase price offered was not very liberal, but I was assured that my employment contract would be very good. I told them I would take it up with my partners.

When I returned to New York, I consulted my wife, who actually owned the store, and her parents, who had supplied some of the starting capital.

They said. "Do what you think best."

My partner, Mike Alpert, said that as long as he got back his investment and some return, he would go along with anything I wanted to do. So the decision was mine alone to make. One thing bothered me about this sale, and I called to talk it

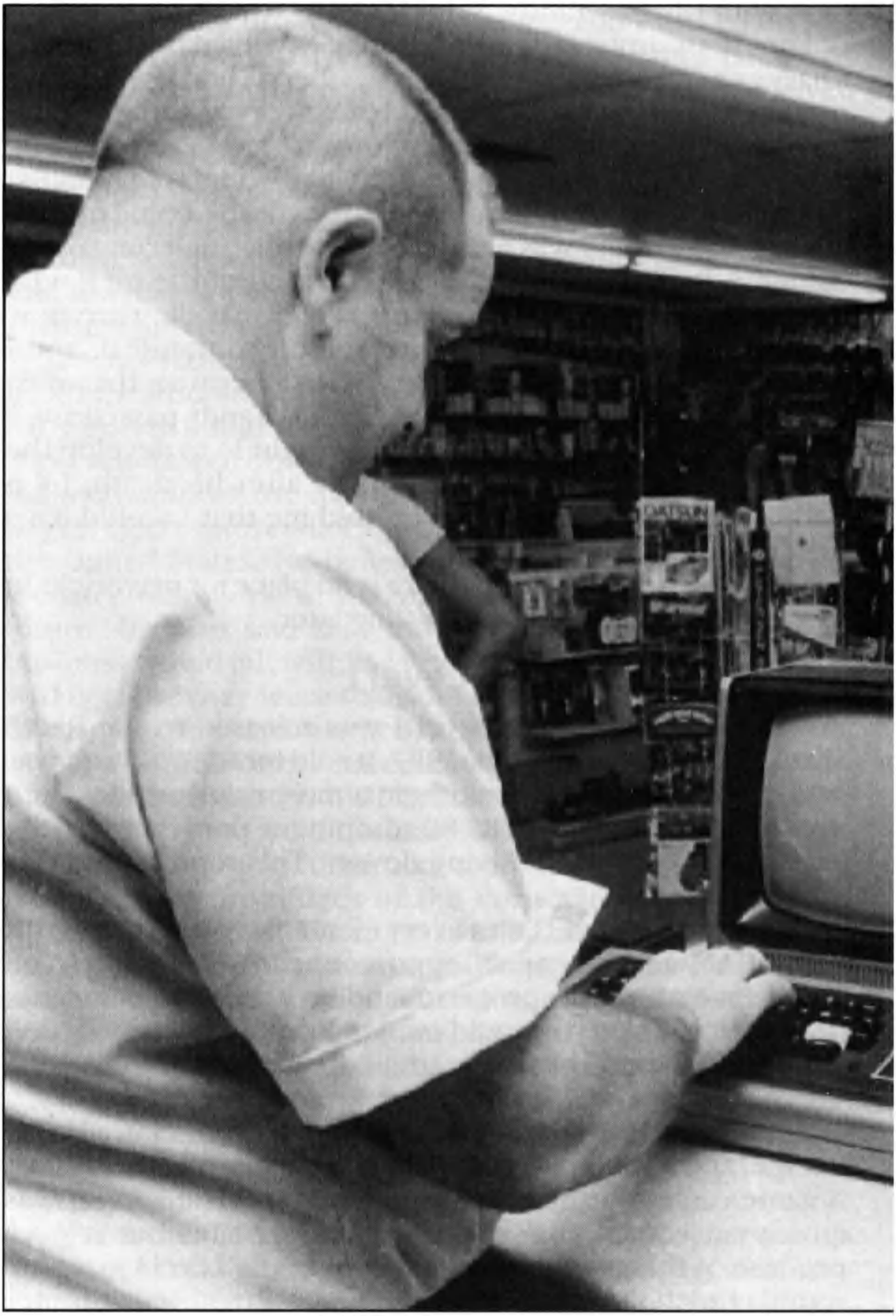
over with Charles Tandy. When I started the store in 1976, I did not draw any salary for a full year. We lived on my wife's salary as a New York City school teacher. It had always been my intention to pay myself that back salary when the store income allowed it. Now, if I sold out, that year would be down the drain. I explained this to Charles and told him that all I wanted was $25,000 for that hard year. He could not see it and told me that I was getting my foot on a high rung of the ladder at Radio Shack. He told me that all of the men who stuck with him when he took over Radio Shack were now millionaires. This attitude turned me off to the deal, and I decided to turn it down. The TRS-80 became the most popular computer ever built, but Charles Tandy passed away a year later. Most of the people he brought in to develop the Model I computer were gone shortly after his death. John Ratliff, Charles Tandy's assistant, told me that I would have never made it at Radio Shack.

"You are a maverick and there is no place for mavericks in this company." He left a short time later.

The TRS-80 Model I, Level I

The TRS-80 Model I, Level I was released to the Radio Shack stores on August 3rd, 1977. It sold for $599.95 and was sold out for months. It took them almost two years to catch up with the demand for TRS-80 computers, particularly in the later versions of this evolving design. This represented millions in lost sales.

The Model I, Level I was a very elementary computer with 4K of RAM and no capability to connect to a printer. You could develop simple programs and save them on a cassette. (If you were lucky, you could even re-load them.) Radio Shack did provide some pre-programmed software on cassettes. There was a Payroll program for up to eight employees, a Menu adjusting program, a Message Center program, a Home Recipe, and a Math Program. These cost from $4.95 to $9.95. A game cassette came with the computer. The TRS-80 was mostly an educational machine at this point, but it gave promise of things to come. As simple as the Level I machine sounds today, it represented the first affordable computer that was ever available to most people. In addition, you could



Radio Shack's biggest advantage was the fact that they already had

hundreds of stores in place throughout the United States and Canada.

buy one, take it home, and use it immediately with the aid of the excellent basic manual that came with it.

The restriction of 4K was not as bad as it sounds today, when we think of programs in terms of megabytes! The BASIC language and the boot-up routines were in ROM and therefore took up no programming space from the usable memory compliment. If you had an Altair, Imsai, SOL, or SWTPC computer, you first had to load BASIC into memory. This could take up 8 to 12K of your precious 16K of RAM so that you didn't end up with more than 4K of programming space anyway.

The advent of the TRS-80 started a whole new group of computer enthusiasts. These new computer owners differed from the hardware hackers who had built their own 8080 or 6800 computers and learned to program in machine language or assembler. The TRS-80 people knew absolutely nothing about the inside of their computers, and Radio Shack was determined that they learn nothing. You voided the warranty if you even opened the case. The Radio Shack Computer Center was to do all the repairs and install all the upgrades. This left the TRS-80 owners with only one outlet for their computer interests, and that was the creation of software. With the introduction of Level II BASIC, the library of available TRS-80 software outgrew any other type.

When the TRS-80 owners first appeared at the computer clubs they were greeted with derision. They couldn't speak the language, they knew nothing about what made computers work, and they used strange software. The name "Trash 80" was pinned upon their machines more from spite than from problems with the machines. Actually, the TRS-80 was built better than almost any computer on the market. There were very few problems with the computer.

The major problem Radio Shack had was with the cassette recorder they sold to be used with the TRS-80. This had problems loading and saving software, and caused a lot of frustrations. Radio Shack soon came out with a new and more reliable recorder, and the problems ceased. The name "Trash-80 " remained, first as an annoyance, then later as a term of affection.

The Radio Shack Model I.

Level II BASIC

The development of Level II BASIC gave the TRS-80 its first real chance to make good on all the promises Radio Shack had been making to the public. This vastly improved language was able to be used for business and home applications. Most of the computers were Level II, but those who had bought the original Level I machines could have their machines upgraded for $120. Video games started to appear using the graphics characters, and the stock of available cassettes in all categories increased.

By 1978, semiconductor technology had advanced to the point where 16K memory chips had come down in price, and it was possible to offer an upgrade to the TRS-80. This removed the original memory chips and replaced them with new 16K RAM. Many users had this upgrade done when they had Level II BASIC installed. It was quite expensive to have Radio Shack make the upgrade and several small companies

came out with do-it-yourself upgrade kits. These sold for about $140, about half the price of the Radio Shack installation, and many users bought the kits, opened their case for the first time, and installed their own RAM.

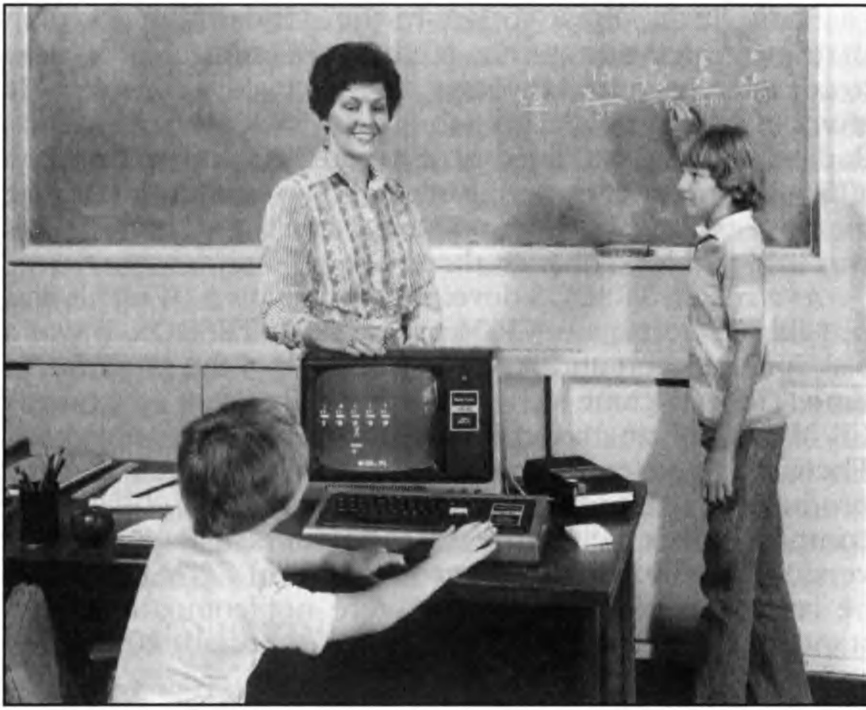
By 1976, Radio Shack was selling the Level II, 16K TRS-80 for $849. This included a numeric keypad, a 6K RAM, and the 12K ROM containing the Level II BASIC. The enhanced BASIC included such features as string handling, multi-dimensional arrays, and multi-letter variable names (Level I only had two letter variable names.) You could name cassette files, and full editing was supported. Since BASIC came in a 12K ROM, the entire 16K was available for user programs. In 1979, this was a huge amount of available memory. The TRS-80 was equal to a 28K system, and it was hard to imagine that anyone would ever need more than THAT!

The Expansion Unit and Disk Drives

The tape cassette had been considered a great improvement over paper tape for storing programs and data for personal computers, but soon it became apparent that it was not a satisfactory solution as a data storage medium. The serial transfer rate was too slow, and the method of converting digital data into audio frequencies for recording was subject to error. The inexpensive tape cassettes, designed for audio, were prone to failure and tape stretch that rendered them unreadable.

The S-100 computers were adopting floppy disk storage. Eight inch diskettes and the recently-invented 5 ½-inch mini-floppies were coming into use. Apple Computer was selling their 5 1/2-inch disk drives for the Apple II as fast as they could make them.

For Radio Shack to develop a disk drive system, a major system unit had to be designed and manufactured. This was the Expansion Interface, a unit that could be mounted under the Video Display. It contained the RAM expansion–up to 32K could be installed. It also provided a real-time clock, serial interface, printer port, and, most importantly, the disk controller. The controller could support up to four floppy disk drives. The TRS-80 Mini Disk System used a diskette with a capacity of 83K formatted. The disk with the operating



The TRS-80 was a versatile educational tool and teacher's aid. The low-cost machine came completely wired and tested. It was also lightweight and easily moved from classroom to classroom. Between the Apple II (also big in schools) and TRS-80s, a whole generation of students were introduced to the personal computer.

system on it had 53K remaining. There were 35 tracks per disk with 2500 bytes per track, divided into ten sectors. Data could be moved in or out of the disk at a rate of 12.5 Kbytes per second, a great improvement over tape cassettes. The operating system, TRSDOS, had to be on the first drive for the system to operate.

TRSDOS - the Radio Shack Operating System

The dominant disk operating system for 8080 and Z-80 CPU's was CP/M. It was used by almost all of the manufacturers of this type of computer, and therefore a considerable library of software had developed for CP/M systems. It was considered the standard for this type of computer.

Radio Shack chose to ignore the standard and develop their own operating system. It was more important for them to completely control their system than make a considerable stock of programs available to Radio Shack owners. In fact, Radio Shack made it impossible to run the standard CP/M on a TRS-80 computer by preempting certain entry points on the memory map. Since these points were in the system ROM, it was impossible to change them.

As a result, TRSDOS developed on its own. While it was possible to port many CP/M programs to TRSDOS, it was a task for an expert and required a rework of the program. In time, TRSDOS came to have as a big a library of software as CP/M and as much support among software publishers. There were several versions of TRSDOS, including some produced by third-party software developers, which were compatible, but included features not found in Radio Shack's versions. Eventually there were versions of CP/M that could be run on the TRS-80. These were not compatible with standard CP/M, and programs had to be specially configured to run on them.

The Radio Shack "Attitude"

When Radio Shack first started with computers, they were completely uncooperative with third part developers of peripherals and software for their computers. They were extremely protective of their name and copyrights. They even tried to prevent magazines from using the phrase "TRS-80," and to prevent third-party peripheral manufacturers from even saying that their products were compatible.

Some of the things they did were very petty and annoying to users. While other manufacturers promoted their products and their name, Radio Shack threatened them with lawsuits. It took a long time, but eventually the "old guard" retired, and Radio Shack eventually changed its policies and opened up connections to other companies and the press.

The Model II TRS-80 Computer

The Model I became the entry point for thousands of businesses to enter the computer age. They could take the first steps toward computerization with the support of Radio

Shack and the large library of TRSDOS software. The cost was very low, and the training was readily available. In parts of the United States, outside the big cities, computer experts were very scarce, but soon there were TRSDOS experts all over, mostly young people who had bought the first TRS-80's and become expert in programming them. The companies that adopted the TRS-80 as a business tool soon demanded a more powerful computer, but they wanted to stay with the software they had.

Radio Shack's answer was the larger TRS-80 Model II, a system using the faster Z-80A CPU, higher capacity 8-inch disk drives, greater memory capacity, and a larger, better video screen. The Model II evolved into the Model 12, Model 16, and eventually into the Model 6000, which used the Motorola 68000 CPU and ran under the Xenix (Unix) operating system. Many of these Tandy business systems were still in operation as late as the 1990s.

The Model III TRS-80 System

At the end of 1979, there were over a million personal

Photo courtesy Radio Shack

The TRS-80 Model III

computers operating in the United States. In fact, it was possible that over a million TRS-80s alone were sold. Radio Shack has never released the figures. One result of this was a marked increase in television interference in homes. A computer in operation generates AC interference at radio frequencies. This can be broadcast through the air, or transmitted through the power lines.

It is the job of the FCC to regulate electronic equipment to see that these emissions do not interfere with communications. They have a massive job to do, and by 1978, a large number of complaints were being received. The FCC published regulations covering personal computers and expected the manufacturers to comply. Most of the computers at that time were housed in metal cabinets which shielded them and made it easy to comply with the FCC regulations. Two computers were housed in plastic cabinets and they could not meet the FCC Regulations. These were the Apple II and the TRS-80 Model I. Apple managed to gain approval by coating the inside of the cabinet with a metallic finish and shielding the cable openings.

Radio Shack, however, could not make the TRS-80 Model I meet FCC regulations because of the separate units and the cable connections between them. As a result, they accomplished a complete redesign of the TRS-80 into a completely self-enclosed desk top cabinet. This was called the TRS-80 Model III. First ready in July 1980, in its cassette version it sold for $699 and incorporated many features that had been included in the Expansion Interface. The Model III had a 12-inch screen, which displayed the standard 96-character ASCII set with both upper and lower case characters. It also displayed 64 graphics characters and 160 special TRS-80 characters. The keyboard provided for entry of all the standard characters, including upper and lower case. There was also a 12-key numeric keypad. The Model III used the Z-80 CPU and from 16K to 48K of RAM. A parallel printer port was provided. Data storage was provided by either cassette or an optional floppy disk controller, and up to two internally mounted floppy disk drives. Additionally, two external floppy disk drives could be connected into the system. There was an option for installation of an RS-232C port for connection to

a modem.

Model III BASIC and MODEL III TRSDOS were improved over Model I, but care was taken to make Mode III software compatible with Model I. If this proved impossible, conversion programs were often provided.

The TRS-80 Model III was one of the most successful computers ever built. It was used in schools throughout the United States, replacing the failing Commodores. It was used in offices, factories, and homes. By 1983, when it was replaced by the Model 4, a couple of million must have been sold. (Radio Shack has never given out the figures.) It was supported by the largest software libraries in existence up to that time, and several other operating systems were written for it. It became the standard grade school computer in thousands of school districts and the mainstay of small business.

TRS-80 Model 4

The TRS-80 Model 4 was the best of the mark and included many improvements that should have been made to the Model III during its years of manufacture. The Model 4 was probably the best 8-bit, Z-80 computer ever built. Unfortunately it came out too late, and had to compete with the IBM PC/XT and the onslaught of the clones. It remained in the catalog for a long time as a replacement for Model III's in schools and offices where they did not wish to lose their investment in software.

The most striking thing about the Model 4 was its white color. Charles Tandy had selected the metallic silver and gray colors, and after he died nobody in the company wanted to change it. To the outside world it looked old-fashioned and brought to mind the "Trash-80" image that competitors had tagged the TRS-80 with. Finally, they caught up with the times and made the necessary changes.

For the first time, the TRS-80 had an 80-column by 24-line screen, with an option to display high resolution graphics. The memory was expanded to 64K with an option to increase it to 128K. The disk drives were double density (184K,) and the keyboard was a full function with three programmable function keys. The operating system for the Model 4 was

TRSDOS 6, which had been developed from LDOS, one of the independent operating systems. In addition, for the first time, standard CP/M was available for use on The TRS-80. Microsoft BASIC 2.0 was provided as the main language.

The Model 4 was designed to be compatible with the Model III. However, when operating with Model III software, the video display was 64-characters by 16-lines and the 48K memory restriction applied. The Z-80, which operated at 4 MHz as a Model 4, only ran at 2 MHz in Model III mode.

Radio Shack also introduced a portable version of the Model 4 called the Model 4P. This had a 9-inch CRT and two disk drives in a portable case.

An Evaluation of the TRS-80 Computers.

The TRS-80 family of computers has never received the credit they deserved as a cornerstone of the personal computer era. Mainly this is the fault of the Tandy Corporation, who failed to understand the importance of public relations in the development of a booming industry. While more TRS-80 computers were built and sold than any other kind, all the attention went to Apple, IBM, and even the small CP/M based machines, which never came close to TRS-80 in popularity and customer satisfaction.

Perhaps much of this was due to Tandy/Radio Shack's position as both manufacturer and retailer. They did not have to fight for shelf space in stores and woo the value-addled resellers. In addition, much of the TRS-80 sales went to schools and small businesses in the hinterlands of the U.S.A.

Not many major corporations were willing to trust their data processing to a "Trash-80" built by Radio Shack, no matter how good the technical people said it was. It was only when IBM made personal computers "respectable" did the data processing departments admit that there might be some value in these little computers.

The CoCo Sideshow

Early on, Radio Shack realized that the dream of inexpensive home computers was a myth that might never be realized. The TRS-80 users constantly demanded new and

Photo courtesy Radio Shack

Radio Shack's TRS80 series of computers played a very major role in bringing the personal computer revolution into the home. The TRS80s paved the way for the more sophisticated machines to come, such as the IBM PC and compatibles that are so prevalent today.

more expensive features, and used their machines for business purposes in the home. Although Radio Shack advertised cassette-based TRS-80 computers, the truth was hardly anybody bought them to use that way. People bought diskless TRS-80's, only to add disks made by outside companies, in order to save money. Still, Radio Shack wanted a home computer. They developed the Color Computer for home use and sold them in stores that didn't even have a computer department.

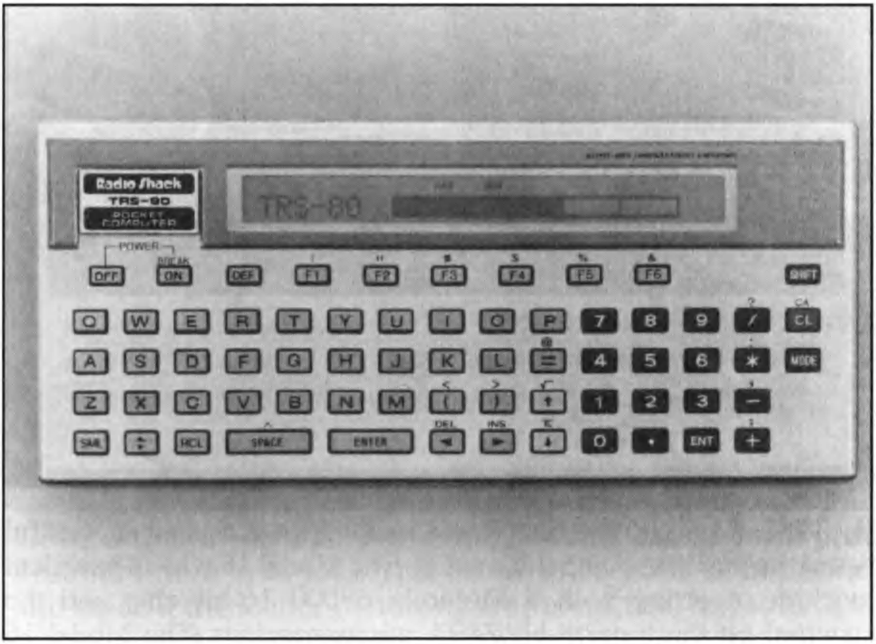
The Color Computer, called CoCo by its many fans, was a remarkable little machine. It used the Motorola 6809 CPU and was an excellent machine in spite of the small amount of memory and other resources Radio Shack designed into it. The CoCo was designed to use cassettes of ROM packs, and although floppy disks were made available their cost was quite high in proportion to the cost of the computer. The loyal fans loved the CoCo, and Radio Shack went through

The TRS-80 Color Computer or "CoCo" as it was fondly called.

several models, constantly bringing the price down and adding new features. Although CoCo was popular with its cult following, it was always a sideshow to the Tandy computer business.

The TRS Model 100

The little TRS Model 100 was one of the most important computers in the history of the industry. It was the first truly practical, portable laptop computer, and it became the prototype for an entire industry. It was just as important as the Altair, or the IBM PC. (However, the Epson HX-20 came out before it. But it had too small a screen, because the technol-



In 1980, over 12 years before palmtops started becoming popular, Radio Shack had one in this TRS-80 Pocket Computer.

ogy of that time could not make a bigger screen for a low price.)

The Model 100 was 11 5/8-inches wide by 8-inches deep by 2-inches wide and weighed only a few pounds. It had a full keyboard that was easy to type on but was very noisy. The display was 8 lines by 40 characters, which was enough to see your text, and it had a built-in 300-baud modem.

The memory was expandable from 8K to 32K, and it only used four AA cells for power, or an AC adapter. The Basic was built in, and it included a serial port, a parallel printer port, and an interface connector for a bar-code reader. The prices ran for $800 to $1300, depending upon the memory. Later, a disk drive was developed for the Model 100, but most users typed on their laptop, and they dumped the data into their PC or MAC when they got back to the office using Lap Link software. This machine spread like wildfire among members of the press, and I can remember going to a press conference in 1984 where the speaker had to ask the reporters to stop

By 1982, Tandy/Radio Shack was making a strong and successful run at the business computer market. The Model 16 was an excellent machine, sporting both a Motorola 68000 16-bit chip and the standard (at the time) 8-bit Z80A microprocessor. The Model 16 could be configured to run Xenix, a powerful version of the Unix multiuser operating system. It looked like great things coming for Radio Shack but, alas, over the horizon loomed IBM's PC, the original XT computer. Suddenly the computer landscape had changed drastically. Numerous computer companies fell by the wayside but Tandy, with its base of Radio Shack stores, survived and still sells computers today. Of course, these computers are mostly IBM clones.

---

clicking their Model 100's because the speaker could not be heard. In 1985, I went to a Space Shuttle launch, and in the press room almost every reporter had a Model 100 connected by telephone to the office.

Even today, when laptops are almost as powerful as desk tops, Tandy still makes this little briefcase computer as the Model 200.

12 

COMMODORE: FROM PET TO AMIGA

The story of Commodore Business Machines must be divided into two distinct parts–the Tramiel era and the post-Tramiel era. It was Jack Tramiel who created Commodore and made it the leader in home computers, and it was his exit that changed the company culture and made it into what it has become today–a bad company with a great product.

To understand Jack Tramiel you had to remember where he come from and the road he traveled to get to the start of the personal computer revolution. A Jewish refugee who survived six years in Hitler's death camps, Jack found his way across the Atlantic where he joined the U.S. Army. The Army taught him how to repair typewriters and stationed him in New York City. When he finished his military duty, Jack stayed in New York and opened a typewriter repair store in the Bronx. This grew into a business machine company selling mechanical adding machines and repairing typewriters.

In 1955, Jack saw opportunities in Canada and moved the company across the border where it continued to expand, and in 1962 Commodore went public. In 1965, the rags-to-riches story took a detour, and Commodore found itself in financial trouble because of the dealings of a former Chairman, whose company failed. As usual, Jack survived the crisis, but the price he paid was loss of control of his company. This was to come back and haunt him later. He made a deal with Irving Gould, a Canadian financier, giving

up his stock in Commodore in exchange for cash, with the provision that some stock would be returned if his rescue operations succeeded. Jack took three million dollars of the money and bought MOS Technology, a semi-conductor manufacturer in Pennsylvania. He knew that the future of all electronic machines was dependent on a supply of chips, and if he had to buy from competitors like Texas Instruments he could not stay in business.

With characteristic fervor Jack pushed Commodore toward recovery, and the company gave him back 8% of the stock.

Among other chips, MOS Technology made the 6502 microprocessor, a near clone of Motorola's M6800, but with a completely different instruction set. In an effort to get the 6502 adopted by computer engineers, MOS distributed them at very low prices. For this reason, Steve Wozniak designed the Apple computer using a 6502 chip, a decision that was to make this one of the most popular 8-byte CPU's. Two other companies were later licensed to make the chip, to meet the demand from Apple, Atari, Ohio Scientific, and others.

Within MOS Technology, Chuck Peddle, the chip's designer, built a single-board computer called the KIM-1. The KIM contained many advanced features and allowed many users to gain a low cost introduction to microcomputing. However, after acquiring MOS Technology Jack gave Peddle six months to design and build a prototype of a real personal computer. The Commodore team put together the first self-contained personal computer which they called the "Personal Electronic Transactior," or PET. The PET was announced in 1976 and first shown at the Consumer Electronics Show in June of 1977. It came with either a 4K or 8K memory, and a built-in green video monitor. The keyboard was built like a Commodore calculator instead of a typewriter keyboard. Programs and data were saved and loaded from a built-in cassette recorder. The price for all this started at a mere $795, a price decision that Jack was later to regret. However, there would be no PETs available to dealers or the public for six months. Commodore announced that if you wanted to order one, you had to pay the full price now and wait for delivery some time in the future.

The Commodore Pet

It was even harder to become a dealer. Dealers had to have a store and a service facility and were also required to post at least $2,500 with their applications, and there was no promise when they would get delivery. Moreover, Commodore played favorites and channeled product to dealers who were on the favored list. In spite of this, the public demand for PETs was huge.

When Jack realized that he had a real winner, he doubled the price and introduced the PET into the United Kingdom and Europe. It was an incredible success, and within a short time Commodore had rounded-up 80% of the market overseas.

Meanwhile, back in the United States, the company was gaining a terrible reputation for lack of support of both users and dealers. As a dealer, I would order 20 PETs to cover orders. They would ship perhaps 10, and of those only 6 would work. We got to be more expert in the repair of PETs than of any other computers because we had so much more experience. We never sold a PET that had not been "burned" in at least a week. However, the machine did evolve, and the calculator keyboard was replaced by a "almost" standard qwerty model (which lacked an alpha period. You had to use a decimal point!) That was typical of Commodore. The printer interface was non-standard, so you had to buy your printer from Commodore. The cassette interface was different–even the parallel port was strange. Later, the cassette was eliminated, and a floppy disk drive was sold as a necessary option. The 2040 Disk Drive had two disk drives, which allowed the user to work with two disks, and Commodore's

engineers found a method of storing 170K bytes on a drive (or about 50 pages of text.) At that time, Apple's drives held 150K and Atari's only 90K! The operating system was built into firmware on the 2040 disk drive rather than being a separate software program. This made it easy to use but kept Commodore locked into obsolete operating systems for long periods.

The overseas success lead to the development of a vastly enhanced computer called the CBM 8032. This business computer had a green monitor, a full business keyboard, and 32K of memory. Larger disk drives were also made available for business use.

There was little advertising, almost no software development (except for programs adopted from European versions) and even fewer dealers. Most people in the United States almost counted Commodore out of business.

One place that Commodore placed most of its United States production was in education. It quickly dominated the educational market by giving a free computer for every two that a school bought. This bargain made it harder for the much more expensive Apples and Radio Shack TRS-80s to get into the schools, although the teachers much preferred them. Selling the schools was one thing, but keeping them running was another. Many of the Commodore PETs ended up in closets because of lack of repair parts.

However, as a result of its overseas operations and the MOS Technology chip business, Commodore had grown into a prosperous company and was actually the third largest personal computer company after Apple and Radio Shack.

In 1978, MOS Technology developed a chip that allowed a computer to use a color monitor or color TV instead of the monochrome display. It was called The Video Interface Chip, or VIC, and it could only display 22 columns in color. The VIC chip had not sold well because the price and availability of color monitors or TVs . Now, two years later, Apple and Atari had color computers, and Commodore had none. Chuck Peddle was lobbying for the development of Color PET and CBM computers. Then, at a meeting called in England to discuss the future of Commodore's products, Jack Tramiel suddenly announced that he wanted to market a color computer right away, and he wanted to retail it for $300!

This was an unheard-of price, but Jack justified it by saying, "The Japanese are coming! So **we** will be the Japanese! We have to compete with ourselves." Tramiel told his people, 'We have to **be** like the Japanese. We constantly have to come up with something new, something better. We have to believe that we are the competition. If we do this, then no one can get ahead of us."

Tramiel knew that the way to beat the Japanese at their own game was to produce a product at a price they could not compete with. The Japanese tactic was to watch carefully while an electronic device was introduced, first at a high price and later at a lower price as the market grew. Once the ground was broken by others, and the quantities being sold were sufficient to support mass production, a Japanese company could then enter the market with an excellent product at much lower price.

Tramiel's strategy was to introduce a new product at the lowest price possible right from the start. He could then capture the market before anyone else could get in and compete. Once the competition matched his low price, he could cut prices even lower since he would have already achieved large-scale mass production.

The little color computer evolved in secret at MOS Technology, Valley Forge, Pennsylvania. It was not a self-contained unit such as the PET. The entire machine was housed in the keyboard case, and its memory capacity was only 5K of RAM. There was a slot for a software cartridge which would contain a program recorded in Read-Only-Memory (ROM) so it did not use any of the 5K main memory. However, the computer could also be programmed with a small version of BASIC that was also in ROM, and the program could be saved on a Datasette recorder. The keyboard was much more standard than the PET model and the missing period was found. The number keys (0-9) served double functions. When pressed at the same time as the Control key, they changed the color of the display. There were eight colors available; white, black, red, cyan (light blue), purple, green, navy blue, and yellow.

The color computer also could display the PET graphics set and even a reverse set of graphics characters. The video

screen was only 22 characters wide, but the characters were nice and large. Naturally, there was no CRT with the little computer, but by then most users had a color set at home, and a video switch was supplied to connect into the antenna terminals. The code name of the small computer was Vixen, but there was much discussion on a final name before settling on VIC-20.

Introduced in January 1981, at the Winter Consumer Electronics Show (CES) in Las Vegas, the VIC-20 was a big success. The press very favorably compared it to the new TI-99/4 and the Atari 400 computers. However, it was not until the Spring CES in Chicago that the final version with FCC approval was available.

The VIC-20 introduced thousands of people to computers, because it was inexpensive and was sold in the mass market stores. It also had a full line of peripherals. Many of the on-line services such as GEnie and Compuserve owe their growth to the low-cost VIC-Modem. This unity allowed large numbers of people to get on line who might have never tried telecommunications. The price and capability of the VIC-20 was a factor that destroyed the market for video games such as the Atari 2600.

The other very important thing about the VIC-20 was that its expansion gave birth to the most popular computer ever built—the Commodore 64.

The Commodore 64 had 16 colors in place of the eight on the VIC-20. It had a 40-column screen rather than 22. It had a music synthesizer chip (SID chip) and easy-to-use graphics called Sprites, and it could use all the VIC-20 peripherals. Most of all, it had 64K of RAM at a time when Apple had a maximum of 48K. It went on sale to computer store dealers for $595, and a few months later was moved to K-mart for $400.

The home computer price war really started between Texas Instruments and Commodore in the summer of 1982, with Texas Instruments issuing a $100 rebate on the TI 99/4A, bringing the price down to $200. Commodore dropped the VIC-20 price to dealers by $40, and let them sell it for any price they wanted. In September 1982, the Commodore 64 hit the computer stores at $595, and then Atari joined the fray

When this brochure was issued in 1983, Commodore was billing their offerings as “The Most Complete Microcomputer Line.” There were nine different models of computers listed, five printers, and six configurations of storage devices from a single floppy disk up to a 7.5 megabyte hard disk. Two models of modems and the Datassette (an external data cassette recorder) were also detailed.

The Commodore VIC-20 (left) and the C-64 made personal computing really inexpensive. Now, almost everyone could afford a computer.

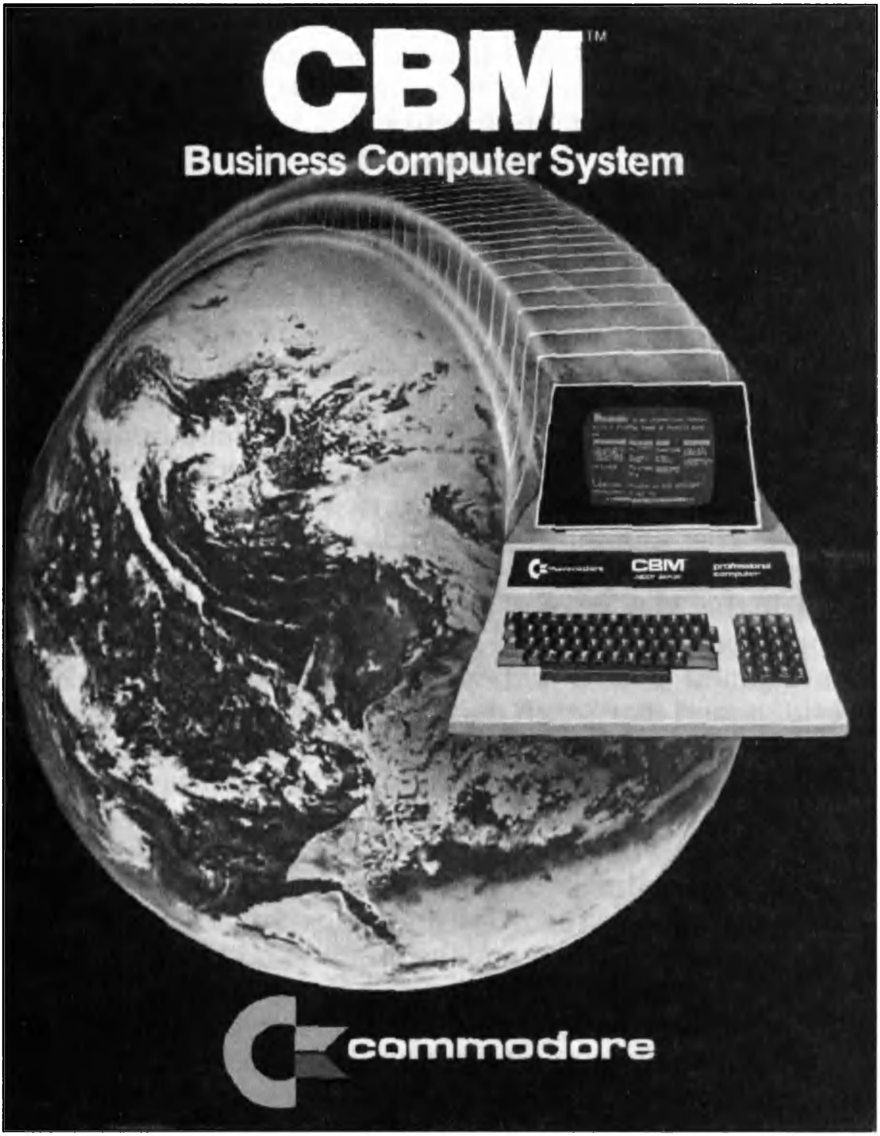
with a $55 rebate on the Atari 400 and dropped the price on the Atari 800 to under $500. Commodore moved the C-64 from the computer stores to mass merchants such as K-mart for $400.

The dealers roared with pain at seeing one of their most profitable incomes going out the door. To a computer store, the sale of a C-64 was only the start on a much more expensive computer system. They made more money on the peripherals and software than on the computer. The VIC-20 price was dropped to less than $130, and merchants started selling them below cost whenever a complete system was purchased.

In February 1983, Texas Instruments again cut the dealer's price of a TI 99/4A by $48 making the retail price $150. Commodore responded by cutting the prices on all peripherals and reducing the price of the VIC-20 to below $100!

Then Commodore came up with a massive "trade-in" offer. They would give a $100 trade-in on any video game, or computer, against the purchase of a C-64! Out came all the old Atari 2600s, Intellivisions, VIC-20s, Sinclairs, and Timexes. People bought Timex Computers on sale for $50 and turned them in on C-64's for $100! The retail price with a "trade-in" was $300.

Atari had just introduced its new 1200XL and found they had to rebate $100 right from the start. However, at the Spring CES Commodore really lowered the boom. They



Like Radio Shack and others, Commodore also attempted to penetrate the business market during the early eighties, but the IBM PC won.

slashed the C-64 dealer's price to between $200 and $250 and cut the price of all their software, including new releases, by 50%.

The blood was flowing all over the home computer industry, but at Texas Instruments it was the worst.

Commodore's costs were so low that even at the depressed prices they actually made money on their computers. However, Texas Instruments was losing $100 million in a quarter, and things were not getting better. Texas Instruments' president resigned, and the company quit the home computer business after taking enormous losses.

There were other fallouts of the price wars, and Atari represented one of the worst to its parent company, Warner Communications. This would have an unforeseen effect on Commodore.

During the summer of 1983, Commodore announced that it had become the first personal computer company to hit one billion dollars in sales. Then, upon this announcement came the totally unexpected resignation of Jack Tramiel. The industry was shocked; there had been little indication that Jack was that unhappy with conditions at Commodore.

The computer press was full of rumors about the cause. It was said that Jack wanted his sons to come into the business in top executive positions, and that Irving Gould objected. It was claimed that Gould wanted to make Marshal Smith President and that Smith declined as long as Jack was in the company. The actual reasons have never been revealed, but Jack and his wife left for a tour around the world, and upon his return he formed a company with his sons. Shortly thereafter, they bought Atari from Warner Communications.

Commodore has had a succession of CEOs and executives and is said to have a revolving door in its executive suite. The C-64, in various versions and the upgraded C-128, have lasted for more than ten years. Their numbers alone make them the most popular computer ever built. Commodore went on to feature the Amiga, a 16-bit machine developed by the Lorrane Amiga company.

13 

THE ATARI STORY

On January 5th 1985, Jack Tramiel was having one of the most enjoyable days of his life. At Comdex in Las Vegas, he was standing in the Atari exhibit, which had been roped off and covered with cloths. The Atari exhibit was the only part of Comdex that was not yet open on the first day of the show. It was awaiting the arrival of the Governor of Nevada, who would formally open the exhibit by cutting a ribbon and allowing the show attendees to see the long awaited Atari 520ST, a new 68000-based computer with the GEM graphics user interface. It was reputed to do everything the Macintosh could do and then some, at half the price of the Mac. In fact it was referred to by the press as "The Jackintosh." The Atari 502ST included color, MIDI sound, and the GEM graphics user interface. The new computer was the rave of the show, and the Tramiel family and their loyal retainers, who had left Commodore when Jack resigned, basked in the glory.

The Atari company, founded by Nolan Bushnell, the inventor of Pong, had grown to become the largest manufacturer of video games and had been sold to Warner Communications. Sales hit 2 billion dollars in 1982, but they plunged to less than 1 billion in 1983 as the public turned to home computers instead of video games. This decline represented a 580 million dollar net loss to Warner. Steven J. Ross, Warner's Chairman and CEO, wanted to unload the business, which he now felt was a drag on Warner and not compatible with the rest of his company. However, it was not easy to find

a buyer who could rescue Atari and was willing to take on the job.

Atari had gone into the home computer business producing a line of 8-bit machines based upon the 6502 CPU. The Atari Models 400 and 800, which were the company's first models, were excellent graphics computers, but had several problems in competing in the highly competitive home market. The Atari 400 had a plastic membrane keyboard and was overpriced at $600. The Model 800 was much better, but it was priced just below the Apple II, and it was perceived as more of a "home" computer while Apple was considered as a "serious" computer.

The later 1200XL systems were not much different except in physical appearance, and although they had 64K of memory instead of 48K maximum on the 800, there was not too much inducement for Atari 800 owners to upgrade their machines. Atari also produced peripherals for their computers, including the Model 1010 cassette program recorder, the Model 1025 printer, and a number of disk drives.

Part of the problem was that Atari, hoping to repeat its success in the video game business, had played its game too close to the chest. They kept important programming information "secret" and disclosed them only to programmers who agreed to market through Atari. Serious application programming companies who were producing 6502 software for Apple refused to comply with Atari's demands and turned their backs on the products. The game programmers, however, seized the opportunity to use the excellent color graphics capabilities of the Atari machines to develop intricate games. By the time Atari recognized their error, lowered the prices of the machines, and tried to woo back the business program developers, it was too late. The software companies felt the potential sales would not justify their conversion costs.

Another problem was Atari's identification with their video games. They had called their game machines "VCS" (Video Computer System,) and now potential buyers felt that their personal computers were merely advanced game machines.

Jack Tramiel had started Commodore Business Machines,

The Atari 400

presided over its growth, and now had resigned from the company. Within a short time, many of the Commodore team responsible for the success of the company followed their leader as the culture of the company changed under the direction of the new management.

When Jack Tramiel left Commodore, Steven Ross recog-

nized the opportunity. What better person could purchase Atari than Jack Tramiel, whose success with low-cost home computers was partly responsible for the decline in simple video games?

After leaving Commodore, Jack and his sons formed a new company, Tramiel Technology Limited (TTL,) with the stated intention of developing new electronic products. At that time, Steven Ross approached Tramiel with the idea of taking over Atari, and they entered into negotiations. By the beginning of July 1984, Tramiel Technologies and Warner Communications became shareholders in each other's companies, and TTL bought Atari.

Tramiel got most of Atari's assets for only $240 million in notes, at a reported very low rate of interest. To give Jack time to re-organize Atari, payments on the interest were not due to start until 1985. Wall Street viewed the deal as Warner selling Atari to Tramiel and loaning him the money to buy it! In addition, Jack got 5-year warrants for one million shares of Warner stock executable at $22 per share-the market price of Warner when the deal was made. With the Atari drain removed from Warner, its stock price would rise, and Jack's profits would further sweeten the deal.

In return, Warner got warrants for 14.3 million shares of TTL stock representing over 30% of TTL. Warner also agreed to assume obligations for past Atari debts. It was a sensational deal for Tramiel and the end of a costly adventure for Warner. All that Jack Tramiel had to do was to make Atari into a profitable business once again.

He wasted no time and flew to California to take over the bloated Atari organization and re-shape it. Tramiel installed his sons at the helm and set to work to cut away the fat and deadwood.

Sam became President, Gary was put in charge of collecting $300 million worth of outstanding receivables, and Leonard was put in charge of software. In one month they reduced the staff from over 5,000 to 1,500. Atari occupied 40 buildings. Tramiel canceled leases and cut that to seven buildings and turned a profit by selling the furniture that filled those buildings. The warehouses at Atari were packed with over one hundred thousand, 8-bit computers that Atari built

but couldn't sell. It was 1985, and 8-bit computers were considered very obsolete. The 16-bit IBM PC and the Apple Macintosh were the desirable computers of the time.

Jack believed that everything would sell at the right price. Atari went on an ambitious project to find the best price at which the Atari 8-bit machines would move out of the warehouse. Since Jack had only paid $80 each for them, a fraction of their original cost, he could afford to sharply cut the price. Moving them out was not difficult. The new Atari team managed to clear the decks for the next generation of computers.

Commodore, which had suffered by the loss of key people who left with Jack and by the Atari price cutting, immediately started a lawsuit charging Tramiel and his associates with taking valuable designs and information when they left Commodore. Jack Tramiel immediately retaliated with a $100 million lawsuit against Commodore. The suit charged that Atari had a previous understanding to purchase the Lorrane Amiga Company because Atari had lent it money to develop the Amiga Computer. Jack charged that Commodore snatched Amiga from Atari by offering a better deal. This suit was without much merit because it happened before Tramiel took over Atari, and Warner had never pursued their claim. Jack's counter-suit did serve to discourage Commodore from their lawsuit against him and his people.

While all these legal maneuvers were going on, the new Atari crew was working on a design that would outdo both the Amiga and the Macintosh and undersell them by 50%. The Atari 520ST was the result. This computer, without the monitor, was priced under $1,000, an incredibly low price for a 1/2 megabyte computer. This gave rise to the motto that Atari used to identify the company, "Power Without The Price."

If price and computer capability were the only criteria for computer business success, Atari would have become one of the giants of the industry. Instead they managed make management decisions that in the long run proved to be unwise. It was said that they managed "to snatch defeat from the jaws of victory."

At the time of the Tramiel takeover of Atari, there were

many computer dealers who specialized in the Atari computers. There was also a sizable user community, and both the dealers and owners must be counted among the most loyal of all families of computer users. They were almost fanatical in their loyalty to Atari computers.

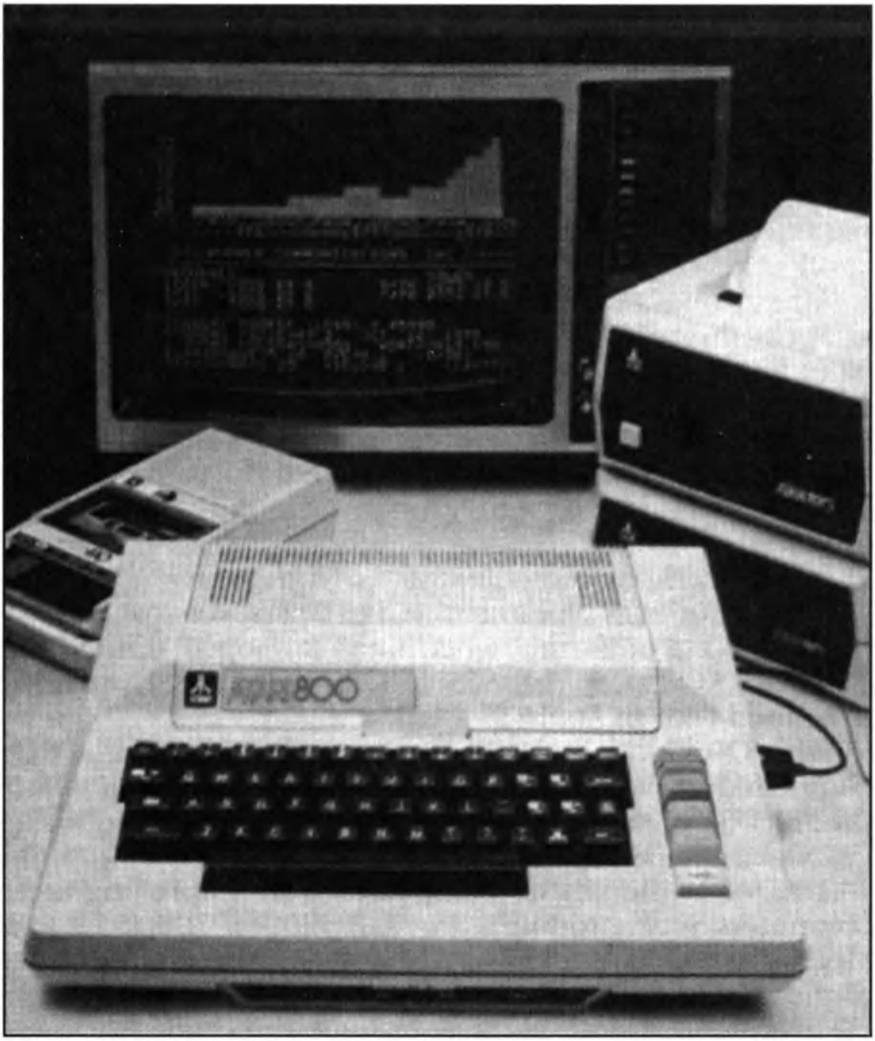
The Atari Forums on Compuserve, led by Ron Luks, were among the largest groups of organized computer users. All of these computer users, plus a sizable contingent of Apple II and Commodore users who had been priced out of the ability to upgrade to 16-bit graphics machines, looked forward to buying the Atari 520ST and represented a huge potential market.

Some of the best graphic software was being written for the Atari 8-bit machines, and developers also were more than anxious to write for the new Atari 520 ST. The potential market seemed almost unlimited.

In retrospect, it is hard to understand some of the counter-productive management decisions made by Atari, even though they might have seemed correct at that time.

Today, it is axiomatic that new computers must be put into the hands of software developers as soon as possible, and companies like Apple employ evangelists to encourage this. Atari, on the other hand, made it as difficult as possible for software developers to get into the 520ST software game. They initially charged them up to $5,000 for a Software Development Kit consisting of a computer and some manuals. Since in the beginning there would not be too many computer users to buy the software, the developers would be unable to recover their large investment for a long time. This discouraged many software developers from writing for the Atari ST.

Wynn Rostek, writing in *Computer Shopper* for October 1985, described how Atari made another bad decision. They squeezed out the loyal, existing Atari dealers for the 8-bit machines. Atari decided to distribute the new computers through manufacturer's representatives who had to qualify the existing dealers. This policy eliminated many dealers who had supported Atari in hard times in the past. As the dealers dropped away to sell other lines, Atari turned to the mass merchandisers and discount mail order houses. This further



The Atari 800

antagonized the dealers who remained, and did not work either. The Atari ST was too complicated a computer to be sold without instruction and dealer support. Atari then went back and tried to recruit a new dealer organization. They kept bouncing back and forth between mass merchants and specialty dealers until neither wanted to do business with them.

There were also severe quality control problems with the

early machines. Due to poor packaging and long shipping routes, the chips in the computer tended to become loose, and the computers would not work. The failure rate in the first few shipments was almost 50%. This was not serious in the case of experienced dealers, who burned-in their computers before selling them, but with mass merchandisers who sold sealed boxes, it was a disaster. It took strict application of quality control to cure the problem.

The second computer Atari made was the Atari 1040 ST with a full megabyte of RAM and with a built-in single floppy drive. The older 520ST did not have room for internal drives, but could support two external floppies. It also had a port for an external hard drive. Provisions to support two floppies and an external hard drive were built into the TOS operating system from the beginning of the first 520ST. One problem with adding hard drives to the Atari ST machines was the non-standard interface known as the Atari Computer Systems Interface (ACSI) which was a modified SCSI-type interface. Third-party vendors enabled users to get around this when they developed boards that converted ACSI to standard SCSI and allowed any SCSI hard drive to be used with an Atari ST.

The 520ST and the 1040 ST were the two computers that comprised the ST line until 1987, when Atari came out with the Mega ST computers. These new machines had a separate keyboard and built-in hard drives.

In 1989, when other companies were improving their computers, Atari produced the Atari 520STE, 1040 STE, and Mega STE models, which were somewhat improved versions of the ST computers.

In the United States in the years since 1985, when the Atari ST line was introduced, the Intel-powered MS-DOS computers and the Apple Macintosh have completely dominated the industry. Commodore's Amiga ran a poor third, and the presence of Atari's ST and Mega was hardly felt except among the loyal fans.

Apple, IBM, Compaq, and the countless clone manufacturers spent millions of dollars on advertising. Commodore advertised in spurts when a new president took over, but Atari spent hardly anything on advertising. Even when they did advertise, they used Atari magazines, where they only

The Atari 1040STE

talked to the converted. And so with few dealers and no ads in general computer magazines, they gained few new customers. Atari's answer to declining sales was always to cut the price. However, with the huge growth of the AT-clone market, they could never match the features and prices offered by the clone manufacturers.

Since the population of Atari ST and STE and Mega ST & STE computers was small, and the operating system was unique, there was no incentive for standard software developers to offer Atari versions of popular software. Only the game software developers featured Atari versions. There were, however, some excellent Atari software systems which did offer a user some excellent programs but little choice.

The more Atari's business declined in the United States, the more Atari turned to overseas sales. In Europe, the situation was completely different from the United States. There were fewer distributors, and they tended to specialize in one type of computer and one country. The prices for machines and software were higher, and Jack Tramiel di-

rected most of Atari's production and marketing efforts into European sales and development. The machines proved very popular and sold very well. Soon, all the Atari production and support were devoted to Europe, and the United States market declined further from lack of support in this country. To this day 85% of Atari's income is derived from outside North America. This foreign success was achieved at the expense of the North American market and caused a lot of resentment among domestic users and dealers.

Basically, Atari did very little development work on new computers and very few updates to the TOS operating system. Atari did come out with machines like the portable laptop Stacy and The 68030 TT line, but very few machines became available in this country.

In all the years from 1985 to 1989, *Computer Shopper* magazine, one of the few general computer magazines who even covered the Atari, had only one cover and feature story devoted to Atari and that featured the packaged Desk top Publishing System put out by the Atari Business Systems Group. This featured a Mega STE computer , a scanner, and the Atari Laser Printer. It had some fairly good DTP software, but the laser printer could only be used with an Atari Mega because the intelligence was in the computer rather than the printer. It was priced about $5,000 for the whole package, not a bad price for the time. The same package now sells for $3,000, but even at that price, it is no great bargain today.

Atari must be credited with marketing one of the first practical palmtop computers. Their Portfolio has an excellent keyboard and a good display. It comes with five built-in applications, a PC card drive for uploading and downloading files to a desk top PC and has 128K of RAM. Originally, the Portfolio sold for about $500, much less than competing palmtops, and was well received. Again, however, Atari failed to come out with new models with featuring provisions for expanded memory, or the new standard flash cards for application software. Instead of offering upgraded models with increased MS-DOS compatibility and new features, they lowered the price. As new palmtops come on to the market at any price, the sales of Portfolio will continue to decrease.

Although Atari is completely out of the large-screen video

game business, the Atari Entertainment Division, with its Lynx color hand held video game, has done much better than the computer division. The Lynx sells well, and there is a fairly large assortment of software for it. The Lynx hand-held game business is only a small fraction of the multi-billion dollar video game business, which is now completely dominated by Nintendo.

Atari's most glaring failure recently took place in the courts rather than in the stores. In a 150-million-dollar lawsuit, Atari has sued Nintendo for domination of the industry, charging Nintendo with being a monopoly, operating in restraint of trade.

Here was a setting for the biggest Atari potential victory since they introduced the 520ST. There was little doubt that Nintendo almost had a monopoly of video game machines. Their software policies were very monopolistic, and at one time Atari had a large share of the business, which they lost when Nintendo came in. In addition, here was an American company suing a Japanese one in a United States court. To make matters worse for Nintendo, there was a strong feeling against Japanese business practices. It looked like Atari could not lose, and 150 million dollars would revive the faltering company.

The trial was a long one. Nintendo admitted they dominated the market and were a monopoly! However, their defense was that they had not acted in restraint of trade. They just provided a better product that people wanted to buy. In addition, they claimed that the many negative business decisions Atari had made cost them their position in the industry. Nintendo was not to blame for Atari's problems—Atari was.

To make matters worse, Nintendo was able to prove their claims, and Atari lost the case. Not only did Atari not get an award of 150 million dollars, but they have to pay Nintendo's costs to defend the case. This could amount to an additional million dollars, in addition to their own legal costs.

Things look very bleak for Atari. The loss of the Nintendo lawsuit and decrease of business in Europe has hurt them. The large PC manufacturers are building clones in Europe, and prices are falling. However, Atari has not given up yet. They may have just one more chance. Atari introduced the

Falcon 030 at the Fall, 1992 Comdex in Las Vegas. This new machine features a 68030 CPU, more memory, and standard SCSI interfaces. This computer will compete with the lower-priced Macintosh computers and should attract a lot of attention. A second machine, now in development, will also be a fast 68040 machine with a large compliment of memory and standard SCSI interfaces. With these new computers selling at traditionally low Atari prices, the wounded company could get back into the business. It seems like the last hurrah for Atari.

T.I. 99/A: THE COMPUTER THAT REFUSED TO DIE

Texas Instruments, the semi-conductor giant, had lagged behind Intel and Motorola in the development of microprocessors, concentrating on the production of memory chips and calculator chips, in which field they were first in the world. Texas Instruments calculator division had engaged in a world-wide price war, in which they had destroyed or crippled the competition for all time. They had brought the price of a "four-banger" calculator from over $100 to under $10 and added refinements while they were doing it.

The Texas Instruments labs had been engaged in R&D to flank the CPU makers by producing a superior microprocessor. The TMS9900 was the result, a 16-bit CPU with advanced features and supported by a family of peripheral chips that provided graphics and fast mathematic processing. The first application of the TMS9900 was in the Texas Instruments line of mini-computers, which were marketed to compete with Digital Equipment's PDP-11 line of computers and Data General's Micro Nova. These were moderately successful, but the field was small and largely dominated by DEC and Data General.

What Texas Instruments was looking for was a large-volume consumer product. Tandy, Radio Shack, and Commodore seemed to be on the crest of a new wave of electronic products called Home Computers, and Texas Instruments was determined to repeat their calculator success in this field with a much superior system. Their philosophy was com-

pletely different from that of other manufacturers.

They meant to control the system completely. The design of their Home Computer would include color, and programming would be in a proprietary language that would be loaded into Read-Only-Memory (ROM's). The ROM chips would be mounted in plug-in cartridges which would be sold to the computer owners. Software developers would have to buy the cartridges from Texas Instruments and program them. Texas Instruments would only license specific software developers and they did not envision much competition among them.

The T.I. 99/4, introduced in 1980, was Texas Instruments's contender for the home computer market. It used the 16-bit TMS9900 running in an 8-bit bus for economy. One of the first places it was shown was at the Personal Computer show in Boston. I had closed the Computer Mart and was looking for a new business to go into, so I took the shuttle to Boston to attend the show and see the T.I. 99/4. It was a low silver keyboard with ports for plug-in cartridges and a color monitor. The quality of the graphics and color impressed me, and I felt that this computer system had possibilities. The listed price was $1,200, which I felt was rather high for a product for the home. I was told that the unit also included BASIC and could support a cassette recorder so the owner did not only have to rely on cartridges but could learn to write his own programs. In addition, there would be a cartridge to load the simple integer BASIC in the machine and another containing Advanced BASIC for more extensive programs and additional memory to support it.

When I left the hall to catch my return flight, I met a Texas Instruments salesman who had tried to enroll our store as a dealer for their advanced line of calculators. We shared a cab and sat together on the flight.

I told him of my interest in the T.I. 99/4, and he asked me if I wanted to become a dealer.

"No," I said. "I am out of the retail business, but I am interested in developing software for the machine."

He told me that Texas Instruments had exclusive contracts with large, experienced firms to develop cartridges. They would not just sell the cartridges to anyone. However,

A complete TI99/A system.

I was free to develop BASIC programs which could be loaded from cassettes. All I had to do was apply to Texas Instruments for a license and pay them royalties. They would then give me information regarding the (GPL) Graphics Programming Language and color system. The catch was that there was only 16K of RAM memory in the basic computer, not enough write any meaningful software. It was definitely not an open system.

In the face of competition from Commodore, Radio Shack, and Atari 400 and 800, the TI 99/4 was a huge flop. Texas Instruments pulled it back and started a re-design. They included a new motherboard known as the "Q" (Quality improved) that used a smaller number of chips. The result was the T.I. 99/4A, which was a very improved machine that could be sold at a competitive price. They eliminated the color monitor and included a TV interface. They improved the keyboard and added more memory in the BASIC machine. The new computers were to be sold through department mass market stores and mass market stores for about $450. The new machines started to sell and gained a group of devoted fans. Then a problem with the power supplies caused Texas Instruments to hold all T.I. 99/4As until it was

solved. During that time Commodore introduced the VIC-20 for $300 and the C-64 for $595, and launched a big promotion for the C-64. By the time the T.I. 99/4A could resume selling, Commodore had launched a price war when they introduced the VIC-20 for less than $300. Texas Instruments responded by offering a $100 rebate on the T.I. 99/4A for Christmas 1982.

The Commodore had several things that the public liked better than the T.I. 99/4A. First, there was much more software available, and it cost less. Second, it was easy to add Commodore's floppy disk; all you had to do was plug it in. The operating software was built right into the disk drive. To expand a T.I. 99/4A required a large and expensive expansion module plus the drive unit. Texas Instruments had never expected that everyone would want a disk drive.

Atari responded to Texas Instruments' rebate by offering rebates on their Model 400 and 800 computers. Texas Instruments came back and extended their rebates until April, plus giving away free speech synthesizers to customers who bought quantities of software.

By the start of 1983, Commodore started selling C-64's to discount mass merchants for resale at less than $400. They also sold VIC-20's at $150.

Texas Instruments responded by cutting $48 off the 99/4A price. Commodore cut further, and the price of VIC-20 went under $100 if the customer bought some software or other peripherals. Texas Instruments talked about meeting the cut later in the spring.

Commodore's next salvo was a "trade-in" rebate of $100 on any computer or video game the customer brought in, even if it didn't work.

People bought broken Sinclairs for $10 and got a $100 off a C-64, which they could take home for $300. Dealers started giving VIC-20's away if the customer bought peripherals and software.

The coup de grâce took place at the 1983 Spring Consumer Electronics Show (CES) in Chicago when Commodore announced that they had cut the dealer price on the C-64 to $200. This would allow discounts to sell the C-64 as low as $200 to $230. Then they announced a cut in their software

prices, taking the last high profit item away from Texas Instruments

Thanks to perfected design and Jack Tramiel's business acumen, and Sig Hartmann' sharp dealing with software vendors, Commodore's cost on a C-64 was less than $100! They had been making money on both hardware and software while running Texas Instruments into the ground!

The debacle at the CES was the last straw for Bill Turner, President of Texas Instruments' Consumer Division. His accountants told him that they would lose $100 million in the second quarter of 1983, and that was too much even for the giant Texas Instrument Corporation. Bill Turner resigned, and on the fateful October 13th "Black Friday" Texas Instruments announced they were ending production of the T.I. 99/4A Home Computer. However, that was not the end of the story.

The inventory of T.I. 99/4A computers was dumped on the market at prices as low as $50. This gave thousands of people the opportunity to own a computer who had not previously been able to afford one, and created a large and dedicated hobbyist user population who organized into User Survival Groups.

The period from 1982 to 1983 was an intensive period of T.I. 99/4A support. Publishers brought out hundreds of books on the computer, and software development was at a peak. Most general computer magazines carried articles on the T.I., and the company supported the computer with peripherals and software.

The production death of the T.I. 99/4A brought on a peculiar situation. The dumping of the hardware at way-below-cost prices created a huge group of users who wanted books, software, and support. While Texas Instruments did not provide it, small supporting companies grew by selling what the new users demanded. User groups grew and became bastions of loyal T.I. support. Software continued be developed and circulated within the group.

At the time Texas Instruments pulled the plug on the T.I. 99/4A, they had been working on the T.I. 99/8, which was known as the "Apple Killer." This advanced machine used an improved TMS9995 display chip and had UCSD Pascal in

ROM. It also had a new rewritten BASIC interpreter and was ten times faster than the T.I. 99/4A. However, in spite of the fact that hundreds of loyal users were waiting for the machine and 100 pre-production models were made, Texas Instruments pulled the plug prior to the 1983 Summer Consumer Electronics Show.

The death of the T.I. 99/4A had an extremely bad effect on the overall position of Texas Instruments as a manufacturer of general purpose and memory chips. The home computer production lines gave Texas Instruments a base on which to plan production of chips and to achieve economies of scale. With that gone, Texas Instruments had a difficult time competing against the Japanese.

The user groups continued on GEnie, Compuserve, and Delphi with support of some small hardware and software companies. One company, Myarc, brought out the Geneve 9940 which was supposed to be the successor to the 99/8. While it did attract some users, it could not compete with the attraction of the PC clones and the Mac.

However, ten years after the official demise of the T.I. 99/4A, a sizeable user community continues to use and support the "computer that will not die."

15 

LOOK TO THE NORTH STAR

In 1975, Lee Felsenstien, who was to become the designer of the Processor Technology SOL, the Osborne 1 Portable Computer, and many S-100 boards, leased a building at 2465 Fourth Street in Berkley, California, which he sub-leased to other people because it had more space than he required for his design activities. That building should become a historic landmark in the personal computer world because it was the birthplace of two pioneer personal computer companies, Processor Technology and North Star Computers.

Processor Technology grew and moved to Emeryville, California and then to Pleasanton, California where it eventually perished. North Star grew up in Berkeley, and then moved to San Leandro where it lasted until the onslaught of the IBM PC and clones.

In 1976, a computer store with the unlikely name of "Kentucky Fried Computers" (A Computer in Every Pot) opened at 2465 Fourth Street in Berkeley to sell computers at discount prices. However, the retail part of the business soon gave way to S-100 board manufacturing efforts when Charles Grant and Mark L. Goldberg, the founders, designed a floating-point math board. The name had been designed to attract people, and it eventually attracted the attention of KFC Chicken Corporation who insisted that it be changed under threat of lawsuit. The name became North Star Computers, and the Hardware Floating Board became the foundation of a successful computer manufacturing business.

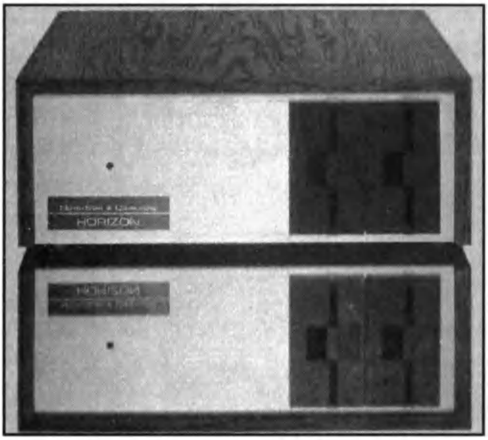
The North Star Floating Point Math Board did just about the same thing that a math-coprocessor chip does for today's computers. It could add, subtract, and divide fifty times as fast as a normal 8080 CPU or Z-80 CPU.

There was a need for such a number cruncher because of the slow clock rates, memory access time, and software in use at that time. Because the Microsoft BASIC in general use did not support operations with the math board, North Star had to supply a special version of BASIC that worked with the board. This math board caught the attention of the computer users and launched the North Star Computer Company. It also started their tradition of supplying software with their hardware products.

The Hardware Floating Point Math Board had a limited market since it cost $359 in kit form, and not all computers had a need for ultra-fast calculation. The next North Star product had a more universal appeal to S-100 Computer users.

Everyone wanted a floppy disk system because the audio cassette recorder had serious defects as a data storage device.

The North Star Advantage series were integrated desktop computers with good graphics. They had 64K RAM, a Z80A running at 4 MHz., and two floppy drives built in.



A double image of a Horizon computer in a 1979 ad touts North Star's double-density disks.

Even the more expensive tape recorders were not really precision devices because they did not have to be. If a few notes of music were lost, it was hardly noticed, but a few bad bits of data resulted in an aborted load or defective program. The cassette interface boards required constant adjustment to keep them working. The most annoying thing about using cassette tapes was that they are serial in nature, and you have to go through the entire tape to get to the file you want. Often two recorders had to be used for complex programs, one to hold the program and the other to hold the data file. Because of these problems, everyone who used a personal computer wanted a floppy disk. The problem with floppy disks was the high cost. In 1976, only 8-inch disk drives were available, and they were expensive. In addition, a disk controller and interface was required, and so was a disk operating system and a special version of BASIC. By the time a user had added up the cost of the complete disk system, he had spent at least twice the cost of his entire computer system.

When Shugart Associates developed the 5 1/4-inch mini-floppy, it seemed to be the answer to the high cost of disk storage. Now all that was required was a low-cost controller/interface board and software. A company called Icom was one of the first to supply this, but their system was still priced too high, and their disk operating system was not too good.

The North Star partners sensed an opportunity and designed a low cost S-100 controller for the mini-floppy. Then they wrote a simple operating system that took very little disk space because the first mini-floppies only held 80K of data. They also wrote a simplified disk BASIC to run on their

North Star definitely had some of the nicest, most creative ads.

system. North Star packaged the whole thing as a kit and started selling it to hobbyists. The demand ran far ahead of the supply of drives, power transformers, and cases for the next two years. This never stopped the hobbyists; they were willing to run their North Star disks uncased, or with a makeshift power supply.

The next chapter in the saga took place in New York City and Hoboken, New Jersey. Many personal computer users in the New York metropolitan area ran the North Star disk system. However, they were not satisfied with the simple North Star operating system which only allowed files to be identified by two alphabetic letters. The North Star disk owners wanted to be able to run CP/M just as the disk owners who had 8-inch drives. All serious software and a huge collection of public domain software was available on 8-inch disks under CP/M, but not under North Star DOS. One reason for this was the small amount of storage space on the mini-floppies. When double-density was developed for 5 1/4-inch

drives, North Star adopted it as fast as they could get new drives . With 160K on a disk, they could run larger programs, and CP/M became a possibility–if only someone could write the CP/M interface software.

Bob Radcliffe, owner of the Hoboken Computer Works retail store, had given this problem some thought and decided that it was solvable by changing the North Star minifloppy disk system to run CP/M. He didn't have time to write the necessary software, but he encouraged a young man named Larry Alcoff, who hung around his store, to do the work. Alcoff, a wealthy young man, was deeply interested in computers, and he did not rely on employment to sustain him. Bob Radcliffe interested him in the task and offered to help whenever needed. Larry went to work, first learning both the North Star DOS and CP/M. After a lot of work, and many false starts, a series of software patches written by Alcoff let the North Star disk system run the CP/M. operating system and to format 5 1/4-inch disks in CP/M format.

At first, Alcoff only sold his patch software to hobbyists who already owned CP/M and North Star drives, and they were able to run CP/M, transferring the software from 8-inch drives to the double density 5 1/4-inch units. Word of this rapidly spread throughout the computer hobbyist clubs, and a lot of patch disks were sold. However, this was just scratching the surface. It took quite a bit of experience to use the Alcoff patches and modify CP/M to run on North Stars. It was no job for a tyro, and this limited sales.

At this point, Tony Gold of the CP/M Users Group entered the picture. Gold had been distributing copies of CP/M public domain software on an exchange basis, or by sale to those who had no programs to contribute. He saw the Alcoff CP/M patches for North Star as an opening that would vastly increase the sale of CP/M. He therefore proposed that he and Alcoff go into business as a distributor of CP/M software. Taking out a direct license from Digital Research Incorporated to market CP/M, they formed a company called Lifeboat Associates. Now, instead of merely selling the software patches, they sold copies of CP/M already configured for North Star. In time, this company became the largest distributor of CP/M software in the world. Whenever a new company

brought out a new computer, or disk system, most likely they would ask Lifeboat Associates to configure CP/M for that new machine and sell the software.

Although it was a side issue, North Star also became involved in a lawsuit with Processor Technology. Processor Tech had been promising its users a powerful BASIC both for cassettes and for disks. It had not been able to supply it because it had no in-house programming ability. All the software it supplied had been written by outside contractors. For some reason, Processor Tech did not want to jump on the Microsoft BASIC bandwagon, so it went to Grant and Goldberg of North Star. They had developed their own BASIC for the floating point math board, and Processor Technology gave them a contract to write the required software. The North Star partners did write an excellent BASIC and completed the contract. They also sold rights to the language to Polymorphic Systems and the Digital Group of Denver, following the example of Microsoft. At this Processor Technology sued them, claiming that they had the exclusive right to the software. After a lengthy trail, North Star won the case.

North Star also greatly benefited from the development of CP/M for their disk systems and sold all the disk systems they could make. In addition, the success of the disk systems enabled North Star to take the next step and become a manufacturer of complete computer systems.

The first machine they developed was called the Horizon-I. It was designed in a table top cabinet that contained the S-100 boards and 12-slot backplane, and either one or two 5 1/4-inch drives. Either single density or double density drives (singled-sided) were available in the first models, and double-sided drives were later available. The Horizon I used the Z-80A CPU and operated at the blinding speed of 4 MHz. Special North Star memory boards were used, and a North Star I/O board was manufactured to keep up with the fast CPU. The Horizon was supplied with North Star DOS and BASIC, but it could also run CP/M and Microsoft BASIC, or another operating system called TurboDOS.

The Horizon cabinet only contained the computer and drive components; a separate video terminal was required for operation.

Hard disk systems of the early personal computer area were huge physically but provided little storage space. This monster with 14-inch platters only had a capacity of 18 megabytes. The unit on top is a tape backup.

The 64K Horizon sold for about $3,000. When the quad density floppy drives came out the Horizon-II was built, and later the Horizon 8/16, which could support two users, had 128K of RAM, and a 15 MByte hard disk in addition to the quad density floppy. This was the last of the mark and sold for $5,400 without the required terminal.

While they were produced, the Horizon computers had the reputation of being extremely reliable computers and very fast for their day. They were considered just below Cromemco in price and quality.

North Star was not a company to rest on its reputation. It believed in research and developing the next generation of computers while selling the Horizons. The new computer turned out to be a self-contained, graphics-oriented machine called the Advantage with a built-in 12-inch monochrome CRT capable of 640 by 260-pixel graphics. The Advantage was a Z-80A machine with 64K of RAM, and its graphics were very advanced for the time. It was equipped with two 360K floppies and ran a special graphics version of CP/M. In 1981, the Advantage was just about the only S-100 graphics computer and was considered as a very advanced design.

In 1982, the IBM PC was arriving on the market in large quantities, and 8-bit machines were rapidly being shelved in favor of PC's. North Star upgraded to the Advantage 8/16 by adding a 8088 CPU in addition to the Z-80A. They also supplied a version of MS-DOS to run on their computer. The Z-80A did the graphics while the 8088 could do character-based computing. The Advantage still only had 64K of RAM, but then most IBM PCs didn't have any more and couldn't do graphics.

Still, with IBM PC's cutting into the market the Advantage only gained a specialized ownership. In 1983, North Star came out with their last computer, the Dimension. This new 16-bit machine had 256K of RAM and 13 slots for IBM PC compatible boards. The Dimension also ran regular IBM Compatible MS-DOS as well as Graphic Dimension DOS. When it came out, this machine was called the best graphics computer ever built, but its $7,350 price was too high for the market. The failure of the Dimension spelled the final chapter in the North Star Computer story and the company disappeared.

16 THE OSBORNE SKYROCKET

Educating our customers was a vital part of running the Computer Mart of New York. People came into the store with a lot of misconceptions about microcomputers. They wanted to know more about them, and until they learned they seldom bought a kit. When we opened the first Imsai kit, we found that Imsai had supplied us with a very interesting book by Adam Osborne, *Introduction to Microprocessors, Volume 1.* This book completely explained how the CPU and all the other parts of the computer worked. In addition, it was composed of bold type paragraphs and standard type paragraphs. The bold paragraphs explained something, and the standard type paragraphs expanded on the explanation. If the reader was familiar with the information, only the bold paragraphs needed to be read.

We loved this book, so I called Osborne and Associates, the publishers, and ordered 50 copies. It turned out that I was their first wholesale customer outside of Imsai. Almost everyone who came into the Computer Mart and was interested in computers walked out with a copy. We sold thousands of Osborne's books over the next few years. Adam Osborne also became one of the industry pundits. His column *From The Fountainhead* in *Interface Age* and later *Infoworld* magazines became widely read, and he was much in demand as a speaker. In 1979, McGraw-Hill noted the popularity of personal computer books and got into the field by purchasing Osborne Associates, which became Osborne-McGraw-Hill Publishing.

Adam Osborne had been criticizing all the companies in the infant industry, and now he decided to form his own company and "do it right."

He had some unusual ideas about what form a personal computer should take. First, he believed that a personal computer should be able to go wherever the owner wanted to work. Second, he realized that it should be a self-contained unit, not a collection of components connected by cables. He also felt that the owner should be able to buy a complete system for one price, including the all important software.

It is a standard joke in the boat industry that a boat is defined as "a hole in the water, lined with wood, into which you throw money." If that was true of boats, it was also true of personal computers. The computer was a funnel into which you poured expensive peripherals and software. Adam Osborne was going to change all that.

He met Lee Felsenstien, the designer of the SOL computer and of many computer boards, at the West Coast Computer Fair and found that Lee also had ideas about designing the first practical complete computer. Adam hired him to design a computer that would include his ideas. After promising Lee twenty five percent of the newly formed Osborne Computer Company, Adam went out to secure the software for the machine. Lee set to work in his Computer Memory workshop.

The machine that Lee designed to bring Adam's ideas to life was different from any personal computer ever produced before. It was the size and had the general appearance of a portable sewing machine, covered in sleek plastic. When the cover was removed, it revealed a standard keyboard,which was placed in front of the open cabinet in which were mounted all the other computer components. In the center was a 5-inch CRT, and a floppy disk drive was installed on either side of the CRT. Under the tube was an open shelf for storing floppy disks.

The video system was one of the strangest things about the Osborne 1, because although it could display a line of 80 characters, you could only see 52 of them at one time. If you wanted to see the rest, you had to scroll the display left or right to see the entire line. Some years later, I asked Lee how

Well, yes, you could carry the Osborne 1, but it wasn't quite as light as this model is making it look. Still, it was a portable computer.

this arrangement came about, and he told me a strange story. It seems that Adam was able to get the 5-inch CRT's very cheap because they had been made for IBM's first desktop system, the IBM 5100, and had been laying unused in a warehouse. Adam brought one to Lee and asked if he could get 40 characters on the screen in a readable size. Lee saw that as a challenge and got 52 characters per line.

The disk drives were single density although double density was in general use. This was because of the portability of the computer, and the rough handling it would receive. Lee felt that the single-density drives were less critical and more suited to a portable computer. The Osborne I used the Z-80 CPU, and it came with 64K of RAM memory. A parallel port for a printer was provided. The entire computer weighed in at about 30 pounds and had a handle on top for portability. Many Osborne users moved their computers by means of a wheeled cart, just like an airline flight attendant moved her lug-

gage. It was by no means a state-of-the-art computer. That was not what Adam wanted. "Adequacy" was the desired condition of the Osborne 1; it would be the overall value of the complete package that sold the system.

The first software Adam bought was a simple monitor program to enable the machine when the switch was thrown on. The operating system was to be CP/M and Adam made a deal with Gary Kildall to get it. He offered stock in the company as part of the deal, but Kildall turned it down because he felt that Digital Research should not own any of its customers, because it was not fair to the others. Nevertheless, he made Adam a very good deal. Adam also licensed C-BASIC from Gordon Eubanks because it was the only compiled Basic at that time. However, he also needed the Basic which was becoming the standard of the industry, so he made a stock deal with Bill Gates for Microsoft Basic. He also asked Gates to serve on his Board of Directors, but Gates turned down the honor.

Osborne intended to supply applications, as well as operating software and languages, and the most important ones were word processing and spreadsheet. MicroPro's WordStar was the most popular word processor at that time, and so Adam approached Seymour Rubenstien with a stock deal for use of the software. Rubenstien was so impressed by the Osborne 1 that he made a deal for WordStar, invested $20,000 in the Osborne company and became Chairman of The Board.

Adam did not do so well with VisiCalc, which was the premier spreadsheet program. He could not make any kind of a deal for bundled software. However, Richard Frank's Sorcim Company had developed a spreadsheet for CP/M called SuperCalc, and Adam was able to secure that.

By the time Adam was finished with his deals, he had assembled a collection of software whose retail price would be $2,000.

The bombshell turned out to be the retail price of the Osborne 1, which was $1,795 including the software.

The Osborne 1 was introduced in April 1981, at the West Coast Computer Faire in San Francisco. It was by far the hit of the show. Here was the first practical portable computer,

and it was being sold at the low price of less than $1,800, including all the programs a user would ever need.

The press commented that it was like buying the software and getting the computer free. The orders swamped the new Osborne Company, and like Altair they were too busy selling computers to get organized. In his magazine column, Adam Osborne had raged against the practices of the fledging computer companies for taking money for computers that did not yet exist; now he found himself doing exactly that. They had hoped to sell 10,000 machines the first year, and they were selling that many in a month.

The Osborne Computer Company prepared to go public, and it was to be the hottest issue since Apple. All of the software company stock holders would make more than they would have made by selling Adam the software at wholesale. Lee Felsenstien would become an instant multi-millionaire. Adam Osborne recognized that he was not an experienced corporate manager, and his fast-growing company needed professional management to make it into the major computer manufacturer he envisioned. To remedy this, he stepped back from hands-on management and hired a team of corporate managers headed by Robert Januch, an executive from the company who made Shasta Soda.

Every rose garden has its thorns, and the price of the Osborne 1 became a target price. Every existing computer manufacturer rushed to get a computer on the market to sell for around the magic price of $1,800 with software. George Morrow brought out such a system, so did Cromemco and Vector Graphic, but the worst competition was from Kaypro who produced a portable with a similar software package, a 9-inch CRT, and offered double density drives. The Kaypro was made by a company originally called Non Linear Systems (NLS) who made inexpensive portable oscilloscopes. It was mounted in a cheap looking sheet metal case, but it proved to be a sturdy and reliable portable computer.

Still Osborne sold all the computers they could make and ramped their production to make even more. Meanwhile, Adam had two new machines under development. One was the Executive, a machine that had a larger CRT and corrected all the defects of the original machine. The other was a

smaller, more portable computer called the Vixen. When the prototypes of these new computers were finished, Adam Osborne personally took them on the road to visit the computer magazines. As Computer Editor of *Popular Electronics Magazine*, in New York City, I was one of the first Editors he visited.

First, I had to sign a non-disclosure agreement which prevented me from writing anything about the new machines until they were released by the Osborne Company. My boss, Art Salsburg, was annoyed at me for signing this paper. He told me that some other magazines would violate the agreement, but if I signed it Ziff Davis would expect me to abide by it. It turned out that he was much wiser than I was, for that was exactly what happened. First, the Vixen was canceled, and then there was a big write up on the Executive in several computer magazines. The result was a complete shut-down on Osborne 1 computers. The dealers and the public no longer wanted the original machine when a new and much improved model was about to come out. With the increased production line in full operation, the computers piled up in the warehouse.

Adam accused the magazines of duplicity, but that didn't restore public confidence in the Osborne 1. They might have moved them out at a special sale price, but the replacement Executive machines became delayed in production. Januch and his "experts" did not know how to cope with the double problem of overproduction of an obsolete model and failure in production of its replacement. When a salesman made a deal to unload a large quantity of Osborne 1s to a New York discount merchant, Januch rejected the deal. Without cash flow, Osborne Computer Corporation failed to meet its bills. The underwriters had drawn back from the stock issue, and on September 13, 1983, Osborne Computer Corporation declared bankruptcy. The failure of Osborne Computer became a classic case history study in mismanagement with the *Wall Street Journal* and other publications featuring studies of what went wrong. To many in the industry, it was just another case of too-rapid growth in an uncharted industry.

17

VECTOR GRAPHIC: COMPUTERS WITH STYLE

One day in 1976, soon after I opened the Computer Mart of New York, I received a surprising phone call from a lady in California. She wanted to sell me 8K memory boards, and I listened because a woman selling computer equipment was indeed a novelty. After speaking with her, I found out that her name was Loré Harp and that she was the president of the company that made the boards.

She was quite persuasive, claiming that her products were superior to the Seals boards I was buying, and they cost less. The boards were supposed to be made with fast static RAM with no wait state. The address lines were buffered, and the switch to change address was mounted on top so the board did not have to be removed to change its address. Her clincher was that she would ship me two boards, and if I liked them I would call her, and she would ship me four more. I would pay COD for the six. If I didn't want them I just had to send her boards back. Well, that seemed like a fair offer, so I agreed.

Thus I became a dealer for Vector Graphic, a company run by two women, Loré Harp and Carol Elly. Loré's husband, Bob Harp, had designed the memory board, and the women did all the work. When the boards arrived, they proved to be all she claimed, and I called and re-ordered the rest. In time I bought both 8K and 16K memory boards, and several other

boards including an analog interface board. They kept adding boards to their line until one day Loré called me to announce that she was producing a full computer—the Vector 1. This was an 8080A CPU-powered machine with a very attractive case. In fact, this was the first computer to come in a choice of colors. I ordered one to see what it looked like. After my attractive computer arrived, Loré called me and told me that she and Bob were coming to New York City with their new computer and several new boards, including a video board.

I made her the same offer I had made OSI. I would engage a meeting room in a major New York hotel and invite the local club members and other computer users if they would put on a demonstration of their machine. The Harps happily agreed and we set a date. I rented a meeting room at the Hilton and sent out invitations. A few days before the meeting, I had a call from Loré asking if I could get a large video monitor so they would not have to haul one from the west coast. I called a friend who had a large studio TV monitor and asked if I could borrow it. He agreed, but asked me to take good care of it since it was quite expensive.

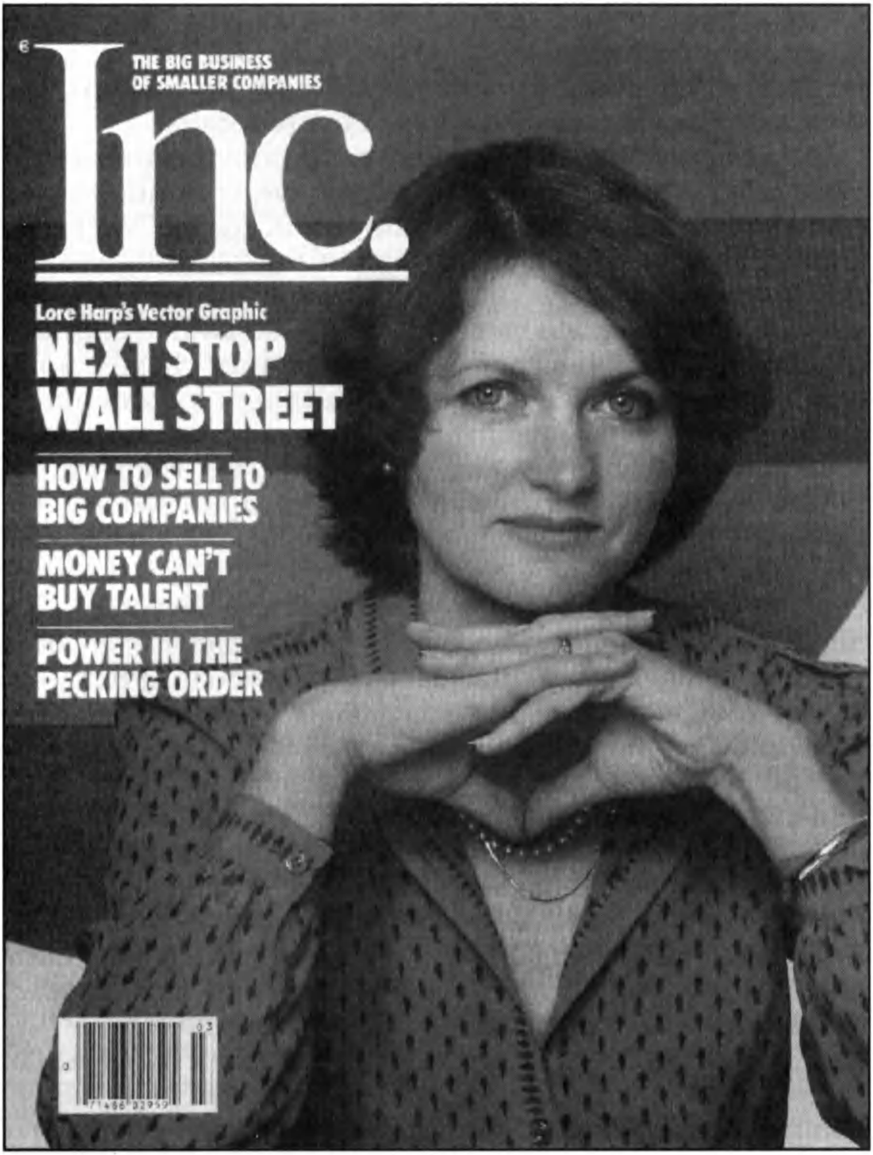
The Harps arrived the day of the meeting with their computer and a keyboard. When they connected it up to the monitor, all it produced was raster traces, no picture. Apparently it was not the matching frequency of the video board, and no amount of adjustment could make it work. We had drawn a rather large crowd, and by the time one of my people arrived from the store with a video terminal, they were unhappy. While we could show that the computer worked with the video terminal, there was nothing unusual about that. The demo turned out to be a disaster.

That evening, in order to forget our problems, my wife and I took the Harps out to dinner. We dined at "The Top of The Sixes," a nice restaurant on top of the Gulf & Western Building in Columbus Circle. Just as we had a second round of drinks and were able to laugh at the day's events, there was a loud bang.

"My God, it's an earthquake!" Loré said.

"We don't have earthquakes in New York City," I answered her.

"I am from California. Don't tell me what an earthquake



For awhile—as shown by this March 1981 cover of *Inc.*—Loré Harp and Vector Graphic were riding high.

sounds like. That was an earthquake!"

Just then, New York City police and firemen poured into the room and announced that we had to leave immediately. The Puerto Rican nationalists had just blown the glass front

off the entire building. Damn, I had just paid the check! After a long delay because they could not find the belt to my wife's fur coat, and she would not leave without it, cops or no cops, we made our way down the glass-covered stairs.

The Harps returned to San Francisco, convinced that New York was a jinx for them. However, we continued to do business with them. They next produced the Vector I+ computer, which included a built-in floppy disk, and the Memorite Word Processor, which included a Diablo printer, a 12-inch monitor, and word processing software. The main product that we bought was their computer chassis, S-100 mainboard, and power supply. I used them to configure a small Alpha Micro system, and on my recommendation several other Alpha Micro dealers did the same. Then one day Loré decided that I had to buy her entire computer or nothing. I did not blame her, but I had no room for another Z-80 Computer in my store. The Vector Graphic line continued to expand and provide complete small business packages using the 6 MhZ Z-80B CPU. The MZ System B which came out in 1980 was quite successful and it was followed in 1982 by the Model 2600, which used two 630K floppy disks, and the Model 3005, which also boasted a 10 Mbyte hard disk. The company did better than the Harp family, which split. Loré remained as president after her divorce from Bob Harp, who left to form his own company, Cordata. Although Loré tried to retire from active management of the company, she was forced to return and take active control as the business declined in the face of competition from the IBM PC. Eventually Vector Graphic went out of business, as did other companies who exclusively built 8-bit computers.

Loré eventually married Patrick J. McGovern, owner of International Data Group (IDG,) world-wide publisher of computer magazines and newspapers such as *Computerworld* and *PC World.*

18 THE DIGITAL DOORSTOP

At the 1980 Personal Computer World show an English firm, led by inventor Clive Sinclair, announced a personal computer that would sell in the United States for under $200. It was called the ZX80, and it was a little wedge-shaped device with an external power supply. Inside was a single-board with a Z-80 CPU, 1K of RAM, and a 4K ROM containing an operating system and a simple version of BASIC. It was designed to be connected to a TV set and it was equipped with a membrane keyboard. The ZX80 BASIC commands were generated by pressing specific keys, and it could run simple programs. Data storage was by means of a cassette interface, and the owner could record his programs and reload them in the future. There was a connector extension to the PC board, which protruded from the back of the case. This served as a connection to peripherals and memory expansion units. At first, there were a few cassettes of games available for the little machine, but most owners preferred to learn to program their own.

The little computer proved to be very popular, and thousands were sold, both in kit form and as assembled units. In addition, there were several magazines started to service the Sinclair users. The principal magazine was *Sync, The Magazine for Sinclair owners,* which grew to over 120 pages and was issued bi-monthly.

Most owners, mindful that the little computer cost so little, were satisfied, but those who had problems found little

help from Sinclair Research LTD, the American branch of the British Sinclair company. Clive Sinclair explained that he could not provide much support for the little computers. He did offer to sell a service policy for future support.

Clive Sinclair, the mind behind the Sinclairs.

Within a year, Sinclair came out with an improved model called the ZX81, which had an 8K ROM containing a much improved BASIC. It still only came with 1K of RAM, but a 16K RAM expansion unit was now offered.

The huge sale of Sinclair's computers, plus a drop in the price of Z80 CPU chip, allowed the Z81 to sell for $99.95 assembled or $79.95 in kit form. Because of the adverse reaction to Sinclair's "no support" comments about the ZX80, the new computer had a 10-day money- back guarantee and a free 90-day service or replacement policy. The 16K memory expansion unit sold for $49.95. It plugged into the rear of the computer and was immediately available for use.

The ZX81, with its 8K Extended Basic and memory expansion, proved much more popular than the earlier machine and spawned a whole support industry providing all kinds of peripherals, expansion units, and software.

Memotech was a company started in England by refugees from Iran, who intended to provide employment for those hundreds of students sent abroad by the Shah who did not want to return to the country after the revolution. They produced a complete line of ZX81 peripherals, including high resolution video graphic interfaces, printer interfaces, and memory expansion modules from 16K to 64K. Their quality peripherals became more popular than Sinclairs, and they were used all over the world. Other vendors provided multi-cassette interfaces and standard keyboards to make the ZX81 easier to use. Many small software companies sprang up to provide an excellent library of cassettes for the ZX81.

At an impressive press conference at the Tavern-On-The-

The Sinclair ZX80, released in 1980.

Green in New York City, in 1981, the Timex Company, manufacturer of low cost watches, announced that they had been appointed sole distributor of Sinclair computers in the United States. They intended to produce an improved ZX81 called the Timex 1000, and they would sell it over the counter in every outlet for Timex Watches. Since Timex was sold in department stores and drug stores, they were going to sell peripherals, software, and instruction books at all their outlets. When the press asked if the druggist was going to fix computers, Timex said that they would exchange them and return the defective units to the factory. Timex lasted for little over a year. They soon found out that computers did not "take a licking and keep on ticking." The service problem was too much for them.

Back in England, Clive Sinclair had come out with a greatly improved computer called the Spectrum which had a mini-tape storage unit built-in and had excellent graphics. However he could not sell it in the United States because of his agreement with Timex.

The Timex 2068, which was to be the U.S. version of the Spectrum, was delayed over a year and was completed right in the middle of the price war between Commodore, Texas Instruments, Atari, and Tandy. Timex had learned a hard lesson—that computers required intensive support, prices

were extremely volatile, and designs change readily. Late in 1982, they pulled the plug on the Timex 1000 and got out of the computer business soon after.

With the price wars and Timex sales of inventory, the price of a Timex 1000 dropped to $39 and then less. Some companies gave them away as premiums, and the popular opinion was that they made a good doorstop because of their wedge shape.

I knew of at least one company who had supported the ZX81/Timex 1000 and continued to deal in them. It bought thousands of the little computers for less than ten dollars. When I asked what they were going to do with them, I was told that they were selling them to engineering companies who built them into all kinds of electronic devices as control units. Where else could they get a Z80 based controller with memory and input/output for less than $100?

Clive Sinclair had been knighted by the Queen for his service to British industry, but now his company fell on hard times, and he lost it to Amstrad, who discontinued the little doorstop computers and the Spectrum as well. Clive formed another company to make a very thin portable computer called the Z88.

19

THE COMPUTER PACK

This chapter is a collection of four short articles. It covers the PolyMorphic, Heathkit, George Morrow, and Bill Godbout stories.

Polymorphic: The Computer for the Professional

PolyMorphic was a strange company, that always went its own way in hardware and software. The thing is, a lot of people went with it, and the company lasted longer than most manufacturers of 8-bit computers.

Shortly after the introduction of the Altair, a little computer called the Micro Altair appeared on the market. It was a rectangular box that contained a power supply and an S-100 motherboard with four slots. You could install a CPU memory and I/O board combined, and a video board, and you would have a fully operational computer in the space of a fat book. If you needed more than four boards, there was an edge connector that allowed two Poly's to be mated, side-by-side. Not only that, but the video board eliminated the necessity for a expensive terminal. All you had to do was connect a keyboard and cassette recorder, and you were in business. Shortly after the first ad appeared, Ed Roberts objected to the use of the name "Altair" so they changed the name to Poly-88.

PolyMorphic's next effort was the design of a table top computer that remained their basic platform for years. The

A complete PolyMorphic system.

original version was known as the 8813. This was an attractive outer wooden cabinet containing the same boards as the Poly-88, a disk controller board, and up to three floppy disk drives with 90K capacity each. Many computers at that time had moved to the new Z-80 but Poly stuck with the 8080 because they had a proven design for a processor board. The 8813 could be used with as little as 16K but for practical purposes more memory was essential. The video displayed 16 lines of 64 characters per line. One problem with the video system was that you could not connect a standard video terminal to the machine. You had to use the built-in video board and an external keyboard.

PolyMorphic did not use the standard CP/M operating system used by most other 8080 computers of the time. Instead, it had its own operating system and its own Disk BASIC. Owners of Poly systems did not seem to mind, and quite a few business applications were written for this computer.

The price of the Poly 8813 was around $4,000, which

placed it in the high end of the personal computer market. From the time of its design, to the end of the market and of the company, The PolyMorphic 8813 was an evolving design and a constant money maker.

In spite of the loyalty of the users, Polymorphic could not sustain its business as a result of the popularity of the IBM PC, and, like many other 8-bit computer manufacturers, went out of business.

Heath: The King of Kits

The Heath Company, of Benton Harbor, Michigan, had been selling kits for radio and audio test equipment and all kinds of electronic devices. Their expertise in this field was completely unchallenged. The thousands of catalogs they sent out brought electronics into every remote part of the United States. Heathkit designs were made simple and broken down into small steps so that failure was almost impossible as long as the builder followed the instruction book step-by-step to completion. They also had some retail stores in major markets where builders could get help with their projects. However, when the microcomputer revolution started in 1975, Heath was very slow to join in. They were selling microprocessor training kits when the new computer companies were selling computers.

The computer companies did not bother to write detailed instruction books and test them for accuracy. Their instructions would read, "Solder in all the resistors after checking the schematic for the correct values. Next, solder in all the capacitors." or "Be careful not to make solder bridges."

The first time I assembled an Imsai kit, I used the photograph in the advertisement to find out how the chassis went together. They never gave us a mechanical drawing of the assembly with the first ten kits I sold.

I remember listening to one of my salesman asking the customer, "You sure you know how to solder this? It sure isn't a Heathkit!"

When Heath finally came up with kits worthy to be called Heathkit, they were strange machines compared with the industry standards. They did not use any of the standard programs and were a breed unto themselves.

The H8 was the first 8080 computer made by Heath. It had a sloping front panel mounting a 9-digit keypad which could be used to program it in machine language. However, it used octal notation rather than the Hex notation which was used on the S-100 machines. It was a bus machine with a unique 50-pin bus. Expansion cards and peripherals were available for the machine, including the memory and speech cards, the H7 floppy disk assembly, and the H10 paper tape reader/ punch. The H8 needed at least 16K of memory for nominal operation and 48K if a floppy disk was to be used. The maximum memory capacity was 64K. The H8 had no internal video but was designed to be used with a terminal such as the H9 Video Terminal which had a 12" CRT.

Heath started with their own operating system, HDOS for disk operation, but added CP/M capability to give their users the ability to use all the software coming on the market for what was becoming the industry standard.

The basic H8 kit sold for only $350, but there was almost nothing you could do with the basic kit. You had to add memory boards and I/O boards and a terminal and disk system to really use the H8.

The Heath Company made a deal with Digital Equipment Corporation to incorporate the DEC LSI-11 CPU into a machine called the H11 which can be thought of as the first 16-bit micro. The resulting computer was supposed to be able to run PDP-11 software, but it was extremely limited because of its puny memory. The H11 was a disappointing effort for the customers, who thought they were getting a cheap DEC PDP-11.

The Heath Company started to fall on bad times at the start of the 1980s. The chip revolution had changed the entire electronics business, and people no longer built electronic kits because entire portions of the equipment were built into a single chip. The flood of imports had lowered the prices of radio, audio, video, and test equipment to levels where the kits cost more than completed units. However, Heath still had its value as a maker of educational and training equipment and texts. The company was bought out by Zenith Radio Corporation, who brought out completely new lines of computers.

The Heathkit H-89 computer in a 1979 ad.

The Heath/Zenith H-89 was the first of these machines and by far the most popular of the brand. It was sold as the Z-89 in its factory-built version, or H-89 as a Heathkit. The Z/H-89 was a desktop-integrated computer with a full keyboard and a 12" non-glare CRT. Next to the CRT was a single 5 1/4" floppy disk drive. The double-density version of the disk controller could store 160K, and there was also a optional external floppy disk and a hard disk option which could store 11 Mbytes. The standard unit came with 48K of RAM, and it could be expanded to 64K. An unusual feature of the H-89 was the fact that it used two Z-80 CPU chips. One ran the computer while the other ran the video terminal functions.

The H/Z-89 was able to run the standard CP/M operating system and all the software available under that system. It

quickly achieved a reputation as a solid workhorse of a computer, and had a large and loyal user community.

The H-89 kit was either $1,895 for a white CRT, or $1,995 for a green CRT. Assembled units were $2,895 for either a built-in disk drive, or a double-density controller for a double-density drive and a hard disk. The factory-built version was $3895.

The engineers at Zenith had an answer to the IBM PC, which was quickly obsoleting the Z-80 computers. It was their Z-100 Series which was also sold as a kit under the Heathkit "H" designation. The series consisted of the Z120 which was an all-in-one business computer with a 12" CRT. The Z-110 was a "flat-top" computer designed with high resolution graphics to mount an RGB color monitor.

The Z-100 series had two microprocessors. One was an 8088 designed to run under MS-DOS and the same 16-bit software as the IBM PC. The other CPU was an 8-bit 8085 which could run CP/M and all the thousands of programs available under that system. All the Heath computers had used their own bus system, but the S-100 departed from that and used a standard S-100 bus! Floppy disk storage was 320K per disk, and a 5MByte hard disk was available.

The Z-100 started out like a house-on-fire; it was an excellent computer, and it had the best color graphics of any machine on the market in those days. The problem was in the incompatible MS-DOS software. The special versions for the Z-100 were not kept current and the S-100 Bus made it incompatible with developments in expansion boards by third parties.

The Z-100 was replaced by MS-DOS-compatible machines from Zenith.

Zenith itself was bought out by Bull Group of France, who closed down the Heath operation completely. The day of the kits was over.

Morrow's Micro Stuff

The largest incubator of microcomputer people was the Homebrew Computer Club, an organization that grew out of Bob Albrecht's People's Computer Company and Community Computer Center run by Fred Moore in Menlo Park,

Morrow was marketing this Decision I system in 1982.

California. He had the idea that it would be a good idea for computer enthusiasts to get together to exchange news and ideas, and so, using the mail lists of PCC, he put out a call for such a meeting. The first was held in March of 1975, in a garage belonging to Gordon French. This evolved into the Homebrew Computer Club, which grew rapidly until several hundred people were attending meetings, and even spawned a San Francisco branch which actually met in Berkeley.

George Morrow, a graduate student in mathematics, became interested in microcomputers and with two friends, Chuck Grant and Mark Greenberg, formed a sort of company to make boards for the Altair. However, Morrow had his own ideas of what he wanted to do, and the group split. Morrow went on his own way, and Grant and Goldberg formed Kentucky Fried Computers, which became North Star Computers.

The first project George Morrow built was a combination 8080 CPU board and front panel board for either the Altair or

Imsai. This board had a keypad on it, and it was used for programming the computer in place of the switches and lights used by both the Altair and the Imsai. To me this seemed like a good idea. The hardest thing to build, in both machines, was the front panel board. Morrow's board eliminated this problem. I sent for one and took it home to build. Upon completion, I found that the board would not work, so I sent it back to Morrow and forgot it for a while. One day the board came home with a note from George.

"Stan," he wrote. "Whoever built this board, never let him solder anything, ever! This is the worst soldering job I have ever seen."

When I told him I was the solder butcher, he laughed and said he meant it.

For years after, George teased me about my soldering. He never let me forget it.

The CPU board was a good idea but was not a success because George had it programming in octal notation while the rest of the 8080 world was using Hex notation. Besides, the hobbyists liked to program by flipping switches.

George's next project was the design of a 16-bit computer using the PACE chip made by National Semiconductor. With his friends, Goldberg and Grant, they would design the machine, and Bill Godbout would market it.

Although Godbout advertised the machine, it was never completed, and the partners split. George next designed a low-cost 4K memory board which was made and sold by Bill Goudbout. Priced at the low price of $189, the board sold very well, and for the first time George Morrow was earning real money from his designs. After a while, George left Godbout's distribution and started his own company, called Morrow's Micro Stuff, to sell his boards. It was a time of rapid expansion in the fledging microcomputer industry. The demand for cheap memory boards was almost impossible to fill. Most of the people buying computer kits did not realize that they would need much larger amounts of memory until after they had built the computer. Then they looked for the most inexpensive way to fill this need. Small companies like Morrows Micro Stuff moved in and sold most of the memory boards.

In 1977, George and Howard Fulmer joined forces to produce a complete computer. This was called the Equinox-100, and although it was well built and came in a very attractive cabinet, it was an 8080 machine at a time that the world was turning to the Z-80 processor. The company was short lived, and George turned to the production of floppy disk systems.

Morrow's new products, called "Thinker Toys" or "Discus," were low-cost 8-inch floppy disk sub-systems, consisting of a controller card, cables, and the disk drive, mounted in a cabinet with a power supply. The system came with CP/M and CBASIC at no extra cost, and for the first time, a S-100 computer owner could be running on a disk for under $1,000. The Morrow systems were a great success.

George again turned to the manufacture of complete computer systems with a line of complete computer systems sold as a package with a video terminal. His company, Morrow's Micro Decisions, made the Z-80 computer with 64K of RAM and either one or two floppy disks. The video terminal was made by a terminal manufacturer. The system was sold with CP/M, two versions of BASIC, and an applications package including WordStar, a spreadsheet, and a financial analysis package. The system also included a shell program, which made it easy to use CP/M. The entire package sold for $1,500 to $2,300, depending how many drives were included.

The Micro Decision system proved to be quite popular for a short time. The IBM PC was turning people toward 16-bit MS-DOS machines.

George Morrow was not one to give up easily. He designed a MS-DOS portable computer called The Pivot. This was different from the bulky "luggables" like the Compaq and IBM Portable that were appearing at that time. The Pivot looked like a small portable radio with a keyboard that folded into the package.

At this time, the Internal Revenue Service had a requirement for thousands of portable computers, and George Morrow's Pivot was the closest to their specifications. The Zenith Corporation was after this contract, and to get it they licensed George Morrow's design for the Pivot. Zenith gave

George a choice of how they would pay for the license. Either Morrow could get a lump sum payment for a non-exclusive license, or an exclusive license with a smaller payment and a royalty on every unit sold. George took the larger lump sum payment because he wanted to bid on the IRS contract himself.

Zenith won the contract and made so many portables they were able to undersell Morrow in all markets. Shortly after this, Morrow Micro Decisions closed its doors.

Bill Godbout—Supplier to the Computer Revolution

Bill Godbout owned a surplus electronics business at the Oakland Airport in Oakland, California, which was both a hang-out and a major source of supply for electronics hobbyists and experimenters. He was an avid supporter of the personal computer industry. He advertised in all the new computer magazines, and he would sell you chips in quantities of ones and twos. This was important because the major electronics distributors wanted nothing to do with the computer hobbyists who were springing up everywhere. The distributors simply were not set up to sell in small retail levels. You had to be a company who had an account with them, and the only way they would accept small orders was for engineering samples. Godbout, on the other hand, would sell you any amount you needed, and he wouldn't wait until your check cleared before shipping your parts.

The most pressing need of all early computers was for additional memory. Most only came with a few bytes of memory, enough to keep the system operating. You had to add a memory board to do any computing.

Usually you had to add several boards, because the first memory boards only contained 4K of RAM. The memory boards used static RAM, and 4K of RAM used about 0.05 amp of power. Aside from the power drain, memory boards were expensive. Bill Godbout realized this, and since his business was a prime source of memory chips he decided to make and sell his own memory boards. He made a deal with George Morrow to design an S-100 board on a royalty basis, and the

Godbout's ads were a fixture in early personal computer magazines.

well known Econoram series of memory boards were born. Selling well below the cost of similar boards from MITS Altair or Imsai, the Econoram was a great success. This brand name was extended later to cover boards with 8K, 16K, and 32K for the S-100 bus and boards for Heath, Digital Group, and Intel

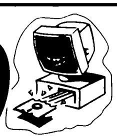
computers.

The success of the Econoram encouraged Bill Godbout to design and build a complete computer. He selected the National Semiconductor 16-bit Pace chip as the CPU, and, after generating a lot of interest with tracer ads, he had George Morrow go ahead with the design. The computer design was never completed, a victim of the fallout between George Morrow and Bill Godbout, and Godbout did not develop complete computers until a few years later.

Eventually, Godbout developed and sold a complete line of S-100 computer boards and complete computers under the name CompuPro. These machines were considered to be of the highest quality and competed with Cromemco. Bill Godbout stopped his electronics component mail order business completely and concentrated on computer manufacturing. He changed the name of his company to Viasyn to reflect this change.

The CompuPro machines were the longest lasting of the S-100 computers, and many of them are still in use. The well-known author Jerry Pournelle was a great fan of CompuPro computers and extolled them in his columns for their well-deserved excellence.

Bill Godbout was in at the start of the personal computer revolution and was in business until the changeover to MS-DOS machines. He contributed much-needed advice and credit to early computer pioneers.



20 PCs THAT NEVER MADE IT

The other day I received an announcement from Digital Equipment Company (DEC). It heralded the advent of something called Desktop Direct From Digital, whose motto was "Taking PCs into the world ahead." I had to read it twice because I could not believe my eyes the first time. It really was Digital Equipment Company (DEC,) the giant of the minicomputer world, who was trying to sell PCs into the direct market. The advertising brochure told me that DEC had decided that the PC was really here and that only they could provide the level of quality, service, and price demanded by their customers.

The computers closely identified with Microsoft MS-DOS, that we call the Industry Standard Architecture (ISA,) are an ubiquitous success. Such a success that we no longer remember that there were many competing PCs that used the same CPU and operating system but were not compatible. Notable among the manufacturers of these failures was the same DEC that now tells us they were just waiting for the right time to bring forth the gem of all PCs. To me it is "deja vu, all over again."

One day, sitting in my office at *Popular Electronics Magazine,* I received a call from the PR folks at DEC, inviting me to a press conference where they were going to hold an earth-shaking product introduction for their new Rainbow Computer. This turned out to be an interesting machine that used both Z-80 8-bit and 8088 16-bit CPUs and was capable

of running CP/M 80 , CP/M 86, and MS-DOS. It was well designed and built, and had an excellent keyboard and color display.

It was priced at $3,500, somewhat higher than the IBM PC. DEC said that many of their users wanted to add PCs to their systems in place of terminals, to allow them to do off-line processing.

It all sounded like an excellent idea, until someone asked if the Rainbow was software-compatible with the IBM PC.

"Well, not exactly," the DEC person answered. "It can run all of the CP/M software, and all of the major MS-DOS software companies agreed to produce Rainbow versions of their products."

There would be a WordStar, Lotus 1-2-3, dBase III, and many, many others.

At the time, this did not seem too much of a problem for the new machine. In the old world of CP/M there were many versions of programs designed to run on varying CP/M platforms. The major CP/M software distributor, Lifeboat Associates, made its living selling CP/M and applications designed for BIOS variations used by different hardware manufacturers. However, the MS-DOS world did not develop in the same way. Either a system was 100% compatible with the IBM PC or it was not. The acid test was the ability to run major software packages, including Lotus 1-2-3 and Flight Simulator. If the computer was not 100% compatible with the IBM PC, it had a rough time surviving.

DEC was not the only manufacturer faced with the problem of compatibility. Texas Instruments with its excellent T.I. Professional was also in the same category. The T.I. Professional had a wonderful keyboard and the best graphics possible in those early days, but it also was non-compatible with the IBM defacto standard. You could use a software program to convert some IBM PC software to the T.I. Pro standard, but not all of it. Despite the rave reviews of this machine, its higher pricing and non-compatibility caused it to fail in the end. You may wonder why such large companies as DEC and Texas Instrument would bring out computers with two strikes against them? Was it fear of litigation with IBM, or just a desire to be different from Big Blue? IBM was

MS-DOS machines that were *not* IBM-compatible rejected popular programs and won few friends.

willing to license their designs. Or, as the clone manufacturers later proved, there was nothing inside that was unique to IBM except the BIOS in the ROMS, and it was possible to make a non-infringing BIOS. Could they have built machines that were hardware incompatible but software compatible? Today, we know that it is not only possible, but it is done all the time, and one hardly even notices.

DEC and Texas Instruments were hardly shaken by the failure of their PC efforts, but for other manufacturers it was

catastrophic. The Victor Adding Machine Company, a division of Kidde Incorporated, was a solid maker of office machines with their own sales force and excellent service. They had enough vision to realize that the microcomputer revolution would in time put their electric adding machines on the scrap heap. So they engaged Chuck Peddle, one of the major designers of personal computers, and made him President of the company. They produced the Victor 9000, a non-IBM compatible MS-DOS computer with many excellent features. Although it came with 128K of memory, it could be expanded to 896K (unheard of at the time). It had excellent graphics with 800 x 400 pixels resolution shown on a very good monitor. The two floppy disks had a unusual variable speed controller and were not compatible with the IBM PC.

21  DOGS AND DINOSAURS

Do not get the impression from reading this book that every little company that put out a microcomputer kit or assembled computer was a success. Nothing could be further from the truth. Most of the product introductions were failures, and some were outright swindles. In addition, some of the worst failures came from large corporations who were victims of product blindness.

In the early days, a company called ECD advertised a wonderful computer that could do all kinds of color graphics. Their ad showed a cat and verbal description of the wonder machine. It never showed the computer. I kept calling them to see this computer, and when they were ready to show it to dealers and investors, they came to New York City. I visited them in their suite at the Plaza. There I was shown a box, but it was not working. They explained that the power supply had just burned out, and they were waiting for another one. I never got to see it, and shortly after that ads stopped.

A friend of mine from the computer club was designing a computer for a large electronic adding machine company who sold to most of the chain stores. He invited me to see his efforts. The computer, called "The Pecos" for some obscure reason, had a built-in data cassette and used an obscure language called Joss. I tried to tell them that everyone had sort of settled on BASIC as a language for small computers, and they would not learn Joss unless there was an excellent reason. My friend and his boss would not listen to me. Joss was a better language, and that is what they would use. The

Pecos never even caused a ripple in the market.

One day, a friend told me I would have a visit from a very rich young Chinese-American to tell me about a new computer he was going to market.

The young man told me about this great idea for a machine which was being made for him in Taiwan. It was called the Video Brain, and it was a cross between a video game and a computer. It had a alphanumeric keyboard as well as game paddles, and it connected to a home TV. The owner did not have to know anything about computers to use the Video Brain. There would be cartridges for games as well as business, including one that turned the Video Brain into a terminal for a time sharing network.

The Video Brain would sell in packaged systems from $300 to $900. The larger systems would have a cartridge containing a language called APL/S which would allow the user to write his own programs and save them on a cassette. The machine used a Fairchild F-8 8-bit CPU and 1K bytes of RAM and 4K of ROM memory. The working memory was contained in the plug-in cartridges.

After explaining all about the system, the young man asked me what I thought about it. I told him I sort of liked the idea because it was a transition from video games to computers, but I suggested that he use BASIC in place of his own language. I also told him he would have a hard sell because the hobbyists who were our principal customers wanted a computer they could program, and business people would look on it as a toy. As for home video fans, it was somewhat too complex for them. He would have to create his own market. When I asked him what the dealer's discount was going to be, he told me 15% and I laughed at that. He told me this item was for big retailers, not little people like me, and that was enough margin for them. So I wished him luck and he left. The Video Brain never made it, although it was carried in some department stores for a while. There was no service and few cartridges. The young man's father stopped the funds, and the company went out of business.

Strangely enough, this same idea keeps re-appearing in the industry. It was made by another company called Spectravision and by Colleco. It has never succeeded. The

The VideoBrain System.

marriage of video games and computers is not a good marketing idea; they are two separate markets. Although computer fans love games, video fans are not computerists.

The Hewlett Packard company suffered from a very bad case of NIH (Not Invented Here) disease in their first personal computer offerings. The HP-83/85 was a self-contained unit with a built-in printer and tape drive unit. It also had a 5 1/2-

inch CRT which displayed 16 lines of 32 characters. The computer ran BASIC and used HP's own operating system. There were four slots at the rear for attaching peripherals. Memory was only 16K but was expandable by means of plug-in boards. Selling for $2,300 to $3,200, these machines were mainly sold to scientific labs for connection to test equipment via HP's HPIB interface.

The HP 86/87 models used a 12" CRT and full 80-column video. They also eliminated the tape storage and used external floppy disks. The most important change was the inclusion of the CP/M operating system. These computers represented an effort to correct the previous mistakes. From that time on, H.P. only offered well-made computers using the standard MS-DOS operating system.

Even experienced computer peripheral companies failed when they ventured into full machine production. Bruce Seals was a highly successful maker of memory boards for S-100 computers. Then he designed the Seals Pup. The Pup was to be a small footprint computer made very strong for adverse applications. It would have a Z-80 and I/O board, and 64K of static memory. As one of my dealers, Bruce sent me a Pup for evaluation. It was strong all right—you could stand elephants on it—but when I opened it up I found the boards were made by Xitan with Bruce's memory. I sent it back, and I wonder if he ever sold any Pups.

The computer I had the most fun with was the Compucolor. This large screen computer displayed great graphic programs in full color. It was not a color TV as we know it, but a special CRT with three guns in it. To get clear color you had to keep the RGB guns in perfect alignment. This was not too hard using the special alignment program, but the Compucolor had a more serious fault. The designers picked the audio cartridge as a data storage medium rather than the cassette. The Compucolor came with an 8-track audio cartridge player connected to the machine. There was no other storage media available at that time. At first it worked well, but in a short time the tape stretch made the cartridges unusable. Another problem was you could not get service on the machine. It cost a fortune to send the machine back for repair, and they took forever to do the work. Compucolor did come out with a

floppy disk unit, but by then we had color on the Apple II, and it did not cost $2,500.

The Exidy Sorcerer was a Z-80 computer built into a keyboard case, with a slot for ROM plug-in cartridges. It featured excellent graphics of 512 by 280 pixels, not bad for that time. It had 8K of RAM expandable to 32K and an 4kROM. The plug-in cartridges added extra ROM up to 16K. The cartridges were the same as 8-track cartridges, but inside, instead of tape, there was a ROM board. Cartridges were available for Microsoft BASIC, Assembly Language, Pilot, APL, Fortran, and Cobol. In addition, the Sorcerer could use cassette tapes, and there were many game and business tapes available. The video text was 30 lines of 64 characters A video monitor was required. The Sorcerer also had a S-100 card edge connector, for connection to an expansion chassis or any single S-100 card by means of a cable. At a price of $895 (less at street prices) the Sorcerer was not a bad deal, and many were sold until the company withdrew from the market because they had not achieved the success they expected for this machine.

Chuck Peddle, designer of the Commodore PET and the KIM 1, left Commodore and became President of Victor Business Products, a company who had made and sold electric business machines for many years. Peddle was to lead them into the computer age.

The Victor 9000 he designed was a fine machine. It used the 8088 16-bit CPU as did the IBM PC. It also used the same operating system MS-DOS and Microsoft GW BASIC. However, it was not compatible with the IBM PC.

The Victor 9000 came with 128K of RAM, but was capable of expansion to 896K of RAM. The video was a green, anti-glare CRT capable of displaying text or 800 by 400-pixel graphics. Two variable-speed 5 1/4-inch floppy disk were supplied. The Victor 9000 was an excellent machine even at the $5,000 list price, with features far in advance of the IBM PC.

Other non-compatible 8088 or 8086 PCs running MS-DOS were made by Texas Instruments and Digital Equipment Corporation. Each had its special features designed to outperform the IBM computer. The Texas Instruments Professional

had the best graphics in any personal computer. The DEC Rainbow featured dual processors designed to run CP/M as well as MS-DOS. Yet both of these machines failed and were withdrawn because they were not IBM-compatible.

Why did the IBM PC/XT with MS-DOS sweep all competition before it? One reason was simply the name IBM. The other reason was advertising, and the fact that these machines were designed for business applications, and businesses were now ready for them. Years ago, Charles Fort said "When its Steamboat Time, someone invents the Steamboat." It was now Personal Computer time. But the non-compatible MS-DOS computers could do everything the IBM machines could do and then some. Why didn't they?

Two things happened; one had to do with software. The programs like Lotus 1,2,3 , dBase III, and WordPerfect or WordStar started with versions for all the MS-DOS machines. However, as they improved their software with new revisions, they found it didn't pay to upgrade the non-compatible versions. There simply were not enough potential sales to pay for the extra work. So in a short time the software on these machines became outdated. No one wants to pay $5,000 for a computer that only runs old software! Then IBM killed them on price. The IBM list price started at the same level as the non-compatibles (I paid $4,000 for my first IBM PC with 128K and two floppies.) However, as production increased IBM lowered the price, and then the gray market started, and you could get a PC or XT for as much as 25% discount. It was wipe-out time for the non-compatible MS-DOS machines as well as the 8-bit computers.

22 HOW DO YOU MAKE A COMPANY DISAPPEAR?

In 1976, Carl Galletti, a member of The Amateur Computer Club of New Jersey, was able to buy a number of discontinued video terminals made by Hazeltine for ITT Data Services which was out of business at that time. These terminals, called AsciiScopes, had been in storage for a long time and were not considered serviceable. Therefore they were sold very cheaply "as is." Carl and his friends found that they could cannibalize the terminals and produce serviceable equipment. Once repaired, these AsciiScopes had every feature you could ever want in a terminal, and in addition they had a built-in modem and a printer port. Once repaired, Carl sold them for $500 to $700 to eager computer hobbyists, who got years of service out of them. The only reason that I mention them is that the sale of the AsciiScopes generated the capital for the founding of a very innovative company called Technical Design Labs, which started in business in 1976. TDL, as it was called, was located in Trenton, New Jersey, and was one of the first microcomputer manufacturers located on the East Coast.

TDL's initial product was one of the first S-100 Z-80 CPU boards and it was introduced at the first Personal Computer Show in Atlantic City, New Jersey, in August 1976. There was no Z-80 software to take advantage of the power of the new chip, but the Z-80 could run all of the existing 8080 software since the 8080 instruction set was a sub-set of the Z-80

Picture of Xitan Meeting

(Seated, L to R): Joel Shusterman (Cherry Hill N.J.—later founded Franklin Computer), Dede Veit (Owner, Computer Mart of New York), William F. Heibling(CEO of Xitan—see text!), and Laura McLoughlin (Xitan Computers).

(Top Row L to R) Tony Jacobs (Xitan Computers), Eri Golembo, Judy Goodman, Stanley Veit (Computer Mart of New York), Howard Bendrot, Ron Cordoba (Computer Mart of New Hampshire), Craig Weller, Larry Stein (Computer Mart of N.J.), Charles Dunning (Computer Mart of Massachusetts), and Oscar Dalem (Computer Mart of Vermont).

---

instructions. TDL also supplied a copy of Roger Amidon's Zapple Monitor, modified from his famous 8080 monitor program "Apple" (no relation to the Apple Computer. Roger used the name first, but never copyrighted it.) Later, TDL came out with a complete line of Z-80 software, including an excellent BASIC, text editor and formatter, and a debugger.

The Z-80 CPU was a great success. The firm grew and

came out with other boards, including I/O boards and memory boards. TDL moved to Princeton, New Jersey, and introduced a system monitor board which had both serial and parallel ports, a fast cassette interface, and the Zapple monitor in ROM. They had trouble with the first version of this board, called the SMB-1, but improved it, and the SMB-II was a success. Next, TDL came out with a line of complete computers under the product name "Xitan." It came in several models–Alpha 1, 2, and 3–and had only 8 S-100 slots because the SMB-II board and the large-sized memory board provided many functions. The Xitan computers had no internal video interface. They used one of the AsciiScopes or relied on the owner's choice of low-cost video terminals, which by then were available from several manufacturers such as Haziltine, Soroc, or Lear Siegler. The Xitan was designed to use cassette data storage, which was the standard of that time, but increasingly owners added floppy disk systems from North Star, Icom, Micropolis, or any other disk system they could interface to the Xitan.

In 1977, TDL ran into trouble because they were unable to obtain the semi-static memory chips they used in their memory boards. The manufacturer had problems in making the chips, and some of the units failed under use. This caused serious cash flow problems at TDL because they were unable to ship ordered systems and boards, and they had to repair all the defective boards returned by previous customers.

In an effort to solve these problems, TDL, which was an engineering company not wise in the ways of business, called in a "business assistance group" to advise and help them. No one seems to know what happened, but quick as a wink, TDL was out of business, and a new company called XITAN emerged from the ashes with the "business experts" in the saddle. Some of the founders found themselves on the outside looking on in bewilderment!

From that point on the plot got even thicker. The new owners went to the major computer stores on the East Coast and made them a proposition they could not afford to refuse. The Computer Mart stores and a few other independent stores were affiliated in a buying company called XYZ Computers, and we had a group contract with TDL. Therefore, we

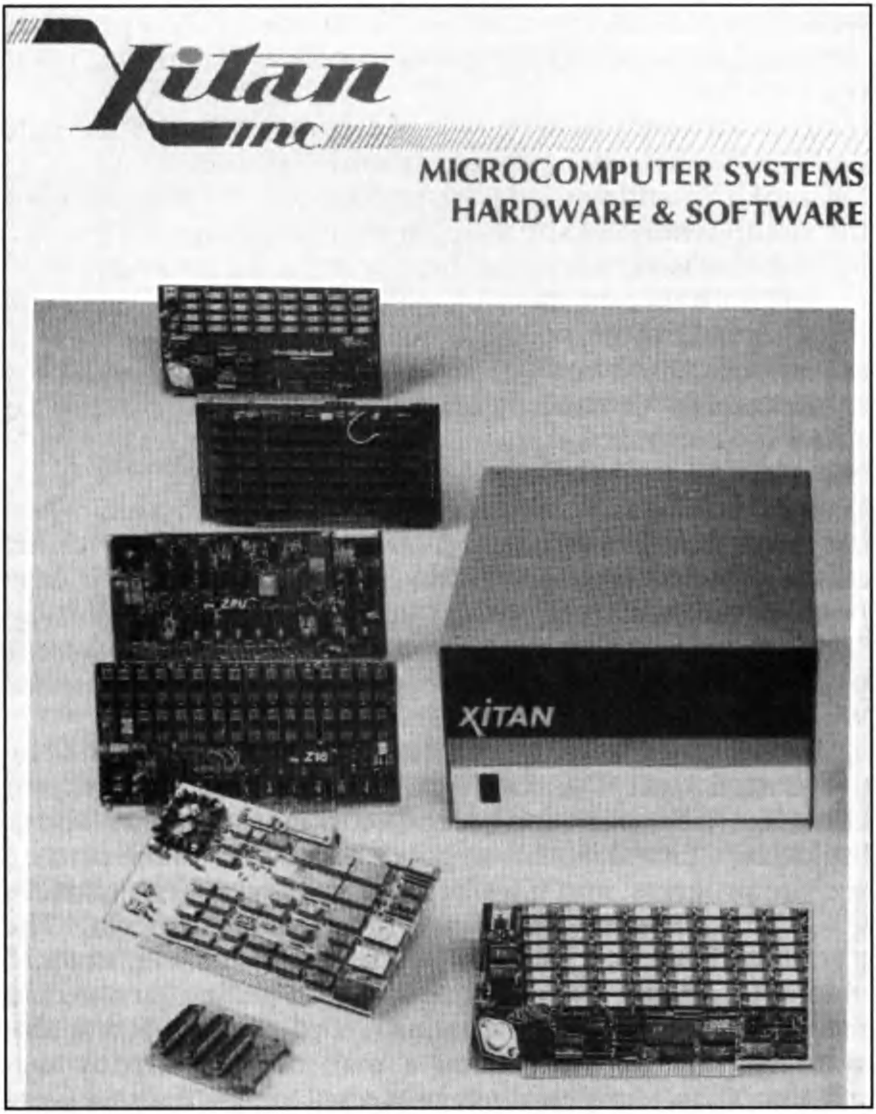
were the first group approached. The new company, XITAN, was going to produce a super computer called The General. This machine had specifications far in advance of anything produced up to that time. It would be a self-contained computer with video and floppy disks built-in, and it would run the most fantastic software, including graphics, word processing, spreadsheet, and database. Remember, this was back in 1978, and they were offering software better than that used on large minis.

The General would have a 4MHz Z80B CPU plus an interrupt controller plus a four-channel DMA controller. It had four sets of memory mapping to permit foreground and background memory of multi-tasking operation.

The keyboard was composed of 77 reed switches, including a numerical keypad and special function keys. The video section generated 80 characters by 24-lines with upper/lower case characters . It had protected fields and graphic capabilities with two levels of intensity. The video had a separate 4K by 16-bits memory of fast static RAM. There was even a BNC connector for connection to a video tape recorder.

Naturally, such a wonderful computer had a super operating system in ROM to support it, but for future expansion there was provision for 96K of additional ROM. The General would come with 33K of RAM (a lot for 1978,) but you could add up to 128K if you needed it. Later expansion to 1 Mbyte was promised. The floppy disk system would store a full megabyte and you could add external drives to increase this. Hard Drives would come later.

These specifications sound more like 1988 than 1978, and we were not stupid. However, XITAN seemed to be willing to pay us if we ordered and they did not produce what they promised. They also offered terms of Net 30 for payment. In addition, we would not have fallen for all this except Neil Kolvin, the head of TDL's software division (later the founder of Phoenix Technology,) said he could do it. In addition, XITAN promised that they would meet all shipping dates, and they would put it in writing and pay damages if they did not make the dates! The discount was substantial, and we would become the exclusive dealers. It looked like a license to print money. Now if we turned



The front of a Xitan brochure.

it down, they would go to our competitors and give them the exclusive dealerships. We all saw a chance to make a lot of money, and we did not want it going out the front door.

So we all made out delivery schedules for Generals and the existing Xitan Alpha Computers, and the company sent us

written contracts. The contracts contained all the promises they had made, everything was in order, in writing. I was ready to sign.

The only person who was not convinced was my wife Dede. She had her famous rubber stamp which read "BULLSHIT," and when I gave her my copy to read she used the stamp wherever she thought something was too good to be true. I was very angry at her for defacing my copy.

XITAN held a big meeting in Princeton and demonstrated The General prototype. It did not do everything in the specs, as yet, but we saw enough to convince us that it would work as promised. We then had a meeting to answer questions about the contracts. It seems that not one brought a copy to the meeting except Dede, so they asked to see her copy. Forgetting about the rubber stamp I put it on the table. When the other dealers saw the "BULLSHIT" stamped all over the contract, it generated a lively discussion. However, the Xitan people had answers to all the questions. Their clincher was, "Look, we are willing to give you 30 days to pay, and we will pay you damages if we don't ship on time. What more could we do to convince you?"

That seemed to answer all the questions. We all signed on the dotted line. The Xitan people then took our signed contracts to the bank and borrowed money to operate and to build The General. So far, so good. We all visited the plant to see the progress, and it looked like they were legitimate.

All the dealers placed ads in magazines offering The General and we started taking orders. I signed a contract to deliver Generals for a franchise company selling Income Tax software systems to accountants, and quite a few other systems. We did notice that a mail order company was offering Xitan Alpha equipment at retail for less than we were paying wholesale. We protested to the company. They told us that the former owners had removed a lot of merchandise and sold it to this mail order house for a very low price. As soon as it was gone, that would be the end of it. There would be no more cut-rate machines. Meanwhile, we could have another 30 days to pay for our merchandise.

Then one day I received a frantic call from the head of XITAN asking me to pay for the equipment I had received. We

From the backof the Xitan brochure. It sure seemed like lots of support was available.

paid the bill, but withheld some money because we had not yet received our scheduled first shipment of The General. We started to smell something bad in Princeton.

At this time there was a big computer show at Madison Square Garden in New York, and we had a large booth. I had been promised a General to exhibit at the show, and a number of perspective buyers were coming to see it.

What they delivered was a defective unit with an external power supply because they said there was trouble with the special power units they had ordered. I refused the computer because I did not want to let my customers see it after all my build-up of The General.

Then one morning, I got a frantic call from one of the Xitan employees I was friendly with. I was told the entire company had disappeared overnight! No one knew where they were or that they were going. How do you disappear a company overnight?

I jumped in my car and drove to Princeton to see for myself. Sure enough, it was gone! Lock, stock, and barrel. Goodbye XITAN! The building was empty. Swept clean even!

Several weeks later I received a phone call from Hubling, the head of the company. He said they had merely moved to a new and expanded plant at a Cape Cod cranberry bog location. They moved at night because of a disagreement with their landlord. (They didn't pay the rent.) Would I please pay my bill?

"Sure!" I told him. "Just send me some Generals to fill my orders." People were getting angry. I would even pay C.O.D. for them.

I got no Generals, although others got Xitan boards and Alphas out of the cranberry bog before they again flew the coop and disappeared for good.

One of the swindlers surfaced in a midwestern city and had a retailer clapped in jail overnight for nonpayment and receipt of goods. He never appeared to press the charges, and a good thing for him because a posse of angry people was converging on that city.

The story of XITAN was one of the less pleasant ones in our industry. However, some of the original founders of TDL acquired the rights to some of the excellent software and formed a company called Computer Design Labs to sell and maintain it. Neil Kolvin re-organized the software branch of TDL in Cambridge, Massachusetts into Phoenix Technologies and produced the first legal PC BIOS.

While walking though the flea market at the Trenton Computer Show in 1984, I spotted an interesting computer on the ground next to a used computer booth. It was the prototype General, and it still didn't work.

23 THE TRIUMPH OF THE IBM PC

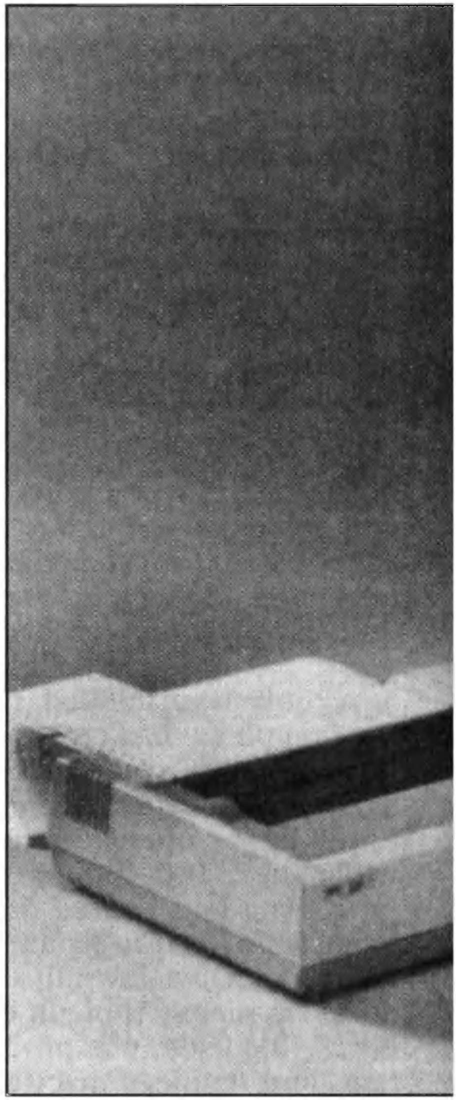
When the PC was introduced in August 1981, the reaction was explosive, and the response to the product was far in excess of the most optimistic prediction made by IBM's marketing department. The advertising and publicity for all the previous computers had built up a picture of the wonders that small computers could accomplish, but the promise had never quite been fulfilled. The Apple, Tandy, and all the S-100 Bus computers had crept into the business world on a very limited basis. They had never been really accepted and were looked upon as tools with very limited applications. The Apple II was often referred to as the "VisiCalc Machine," while the S-100 computers were mainly used for word processing and limited database applications. Despite its intensive advertising and excellent products, Radio Shack could never live down the name "Trash 80," while Commodore was merely thought of as a game machine. Now "Big Blue," IBM itself, was producing a personal computer, and that alone lent legitimacy to the industry.

The world of business was convinced that if IBM built personal computers, then PCs must be the future trend of the computer industry. For the first time, large corporations placed volume orders with IBM for microcomputers.

Despite the general attitude of business toward personal computers, the "state-of-the-art" of the existing microcomputer industry was quite advanced at that time. There were S-100 Z-80A Computers that had been in pro-duction for five

years and ran some fairly good software. There were even multi-user systems that could support eight to ten users and could supply each user with enough memory to do some meaningful work. Some of these computers even had hard disk drives (then called "Winchester" drives) and used operating systems far in advance of the new PC-DOS offered by IBM. The Apple II and III computers had a huge library of software. Apple computers were easy to use, and they were capable of very complex color graphics.

The brand new IBM PC had none of these capabilities and almost no existing application software. Yet the PC had the magic letters IBM on the front panel, and that alone was enough to inspire confidence in the potential of the computer. Customers were convinced that all the rest would come soon enough.



By the end of 1981, demand for IBM PCs so exceeded the supply that a buying frenzy built up. While they could have sold 50,000 computers within the first few months, the IBM Entry Level Division actually built and sold less than 20,000. Dealers were actually selling the machines at above list price and tying-in software with the order. To relieve this situation, IBM exerted all its productive genius, and when they finally ramped-up production during 1982, the PCs fairly flew out of the factories.

The advent of the IBM PC killed off a lot of good computers.

IBM had never had a product like this before, and there were many bugs in the distribution stream. The selection of IBM PC dealers had been made very carefully, and the computer dealers had really competed for the privilege of selling the PCs. Although the Computerland chain had been selected as the first group of non-IBM dealers, each individual

store had to qualify as a PC dealer. Very few independent computer stores made the grade and qualified as IBM dealers, and this created a lot of pressure on IBM to expand the ranks of authorized dealerships.

The computer industry had always operated on a system of dealer discounts based upon sales volume. IBM therefore used this industry standard yardstick in pricing the PC to its dealers: The more computers sold, the greater the dealer's discount. In addition, once the dealer's volume had been established, each dealer had to maintain their volume quota to keep the valuable IBM franchise.

While the PCs were in short supply, the dealers continued to place massive orders, knowing that they would only actually get a portion of their order, on allocation. The dealers were sure they could sell all the computers they received right in their own stores. However, once the pipeline of back orders was filled, IBM was able to produce all the computers that were ordered. The dealer could not go back and order in smaller quantities, because then the reduced discounts would not give them a large enough profit margin. They were also afraid of losing their dealership if they did not keep up their quotas. Under this marketing pressure, something had to give, and what resulted was the establishment of the so-called "Gray Market."

The overstocked dealers found that they could sell their excess PCs for cash to other dealers who were not IBM-approved. The IBM dealers only made a very small mark-up on the units they wholesaled, but they retained their large discount on the units they kept. Soon, more units were flying out the back door than were sold to customers who walked in the front door. The gray marketeers who bought the machines had to pay cash to the IBM dealers, and the "gray" dealers could not afford to keep the computers for any length of time. They had to turn them over fast to get the cash to buy the next load. The gray market dealers therefore sold IBM PCs to retail customers at a sharp discount. The "street price" of gray market IBM PCs dropped daily as more and more computers were funneled into the gray market pipeline. Soon, even the authorized IBM dealers were discounting the computers they kept for sale in their own stores. The IBM

dealers also had to move their monthly quota of computers before the next load came in, because they had to pay the IBM invoices on time. The authorized dealers complained bitterly to IBM about the gray market and its effect on their business, but IBM seemed not to hear their complaints. The factories were turning out thousands of machines, and they were all selling at the established factory price. IBM did not want to cut the flow no matter who was selling the machines at retail. It was claimed that IBM itself was creating the gray market, since they derived the greatest benefit from it.

There were other problems created by the gray market that were not so obvious at first. The computers were supposed to be serviced and maintained by the authorized IBM dealers. Naturally, these dealers refused to service the gray market machines, and the owners of these machines then called IBM looking for help. No matter where they had bought their computer, the retail customer saw the IBM logo on the front panel, and that meant their problems were IBM's responsibility. IBM finally had to respond to this demand for help, by establishing a toll-free telephone number. However the Help Line was immediately swamped, and callers could not get through.

Demand always creates supply, and while the IBM dealers were selling fewer computers because of the gray market, they expanded their service business. They did take repair work on gray market computers at a price, charging stiff fees for their work. The IBM PC was so constructed that most repair could be accomplished by simple parts replacement. Within a short time, third-party parts such as power supplies and expansion boards appeared on the market and helped create the huge IBM PC peripheral and expansion board market.

As the population of PCs increased, so did the supply of application software. Although the first PCs had to rely on the use of the "Baby Blue" Z80 CPU board and CP/M software, the software publishers rushed to convert popular applications programs to run under PCDOS on the IBM PC.

The biggest demand was for a spreadsheet that could take advantage of the potential of the PC. A version of Visicalc, the pioneer spreadsheet, had been introduced with the first IBM

PCs, but it provided no advantage over the Apple versions. Although the VisiCalc company worked frantically to develop an advanced system, but it never came out. Meanwhile Mitch Kapor, who had developed a graphics program to compliment VisiCalc, formed a new company and developed an advanced spreadsheet capable of incorporating text and graphics. He called his system Lotus 1-2-3, and it quickly dominated the PC spreadsheet market, becoming the most widely used PC program. VisiCalc disappeared from the market.

In the database category, Ashton-Tate adapted its dBase II program to the PC as dBase III and retained its dominance of that branch of the software industry. The first word processor supplied with the PC was Easy-Writer, which was inferior to such standards as WordStar used on CP/M machines. The market for PC word processors remained wide open to competition until very recently when WordPerfect and Microsoft Word seemed to dominate the field. Other types of software for the PC proliferated, creating the huge and varied industry we have today.

Microsoft took advantage of the multitude of gray market PCs to sell its own version of the PC operating system. It had sold IBM the non-exclusive rights to use the system with the expectation of also selling it to non-compatible 16-bit computers. Indeed Microsoft did sell its operating system for use on such machines as the Victor, the Texas Instruments Professional, and the DEC Rainbow, all of which attempted to compete with IBM PC.

The IBM version of the operating system was called PCDOS, and the Microsoft version was called MSDOS. Actually, there was very little difference between them. The differences were in the Basic Input Output System (BIOS,) which was the link between the computer and the operating system, and was necessary for the operation of the system. Microsoft did not sell a BIOS, or license one with their operating system. Each computer company had to provide their own BIOS, and it could not be a copy of IBM's BIOS, which was provided in a Read-Only Memory (ROM) chip and was proprietary and protected under copyright laws.

The gray market IBM PCs did have the IBM BIOS chips and

could run under Microsoft's MSDOS version of the operating system. The clones which came later needed a non-copying BIOS to avoid legal action by IBM. Several early clone manufacturers, including Columbia Computer Company, were successfully sued by IBM for copying their BIOS. A software company called Phoenix, which had been a division of the ill-fated Technical Design Labs, was the first to develop a legal MS-DOS BIOS that did not infringe on IBM's copyrights. They did this by a process known as "reverse engineering."

To reverse engineer a software system, the programmers are given the results to be achieved, but they do not know what they are working on. As they program, their results are taken away and examined by another group, who compares the code to the code of the product being reverse engineered. It there is any similarity, the code is returned to the programmers with instructions only to "do it another way." By this slow process, a complete system to accomplish a software goal can be developed in such a way that it is completely non-infringing.

Another difference between PCDOS and MSDOS was in the BASIC language. IBM provided a version of cassette BASIC in their BIOS chip. This was a non-disk version which could not be saved on a floppy disk. The disk-based PCDOS added the parts of the language that enabled disk operation. This was called BASICA, and it would not work with a non-IBM computer. When a user with a clone called BASICA, it crashed the system. Microsoft sold a complete BASIC disk-based program called GWBASIC (Gee Wiz BASIC) for use with its MSDOS operating system. Functionally it was identical to BASICA.

The IBM XT Computer

The first IBM PCs were equipped with either one or two floppy disks, giving them either 160K or 320K bytes of storage. Later, the capacity was increased to 360K or 720K of storage by advances in the operating system.

Meanwhile, the Winchester hard disk technology of the industry had been improving. Where formerly hard disks were large platters 14 inches in diameter and then 8 inches

in diameter, now units as small as 5 1/4 inches could store as much as 5, 10, or even 20 megabytes of data. Independent manufacturers started to provide such units for the IBM PCs, although PCDOS Version 1 did not support hard disks. They got around this problem by starting the system with a floppy disk and then loading a hard disk driver program.

IBM and Microsoft each quickly realized the value of hard disk support for the IBM PC computers, and IBM developed the IBM XT computer, which had one or two floppy disks of 360K capacity each, plus a 10 megabyte hard disk. In addition, the IBM XT had an optional color graphics adapter, optional IBM Color Display monitor, and an optional internal communications modem.

Microsoft provided an advanced version of the operating system which allowed the computer to initialize from the hard disk without the use of a floppy system disk. Upon its release in March 1983, the XT took its place in the IBM PC family, adding to its total sales without diminishing the sales of the PCs.

24 THE IBM PCjr.

The initial success of the IBM PC was mainly due to business users, software developers, and advanced hobbyists. The cost of the PCs and XTs and their peripherals were too high to attract the so-called "home computer" market which was dominated by Apple, Commodore, Texas Instruments, Tandy, and Atari.

IBM's marketing research showed that these existing inexpensive computers had hardly reached the potential base of professionals, students, and family users who wanted to process information at home. The concept of a home computer that would sell for less than an Apple II and would be upwardly compatible with the IBM PC, although of lesser capacity, seemed to offer a huge market. IBM, dazzled by the success of the PC, decided to own this market with a machine that could be sold by the mass marketers such as K-Mart and J.C. Penny. With this idea in mind, the development of the IBM low-end computer started.

It was not too long before the difficulties with this idea became apparent. The mass market retailers were not, and could not, be qualified to maintain and service the machines they sold. They were used to exchanging any defective equipment for the customer and returning it to the manufacturer for full credit and replacement. In addition, their sales people could not take the time necessary to sell a computer, and they did not have the necessary training to do so. Mass market stores sold things in factory sealed boxes, on a "take

it or leave it" basis. For this reason, Apple did not sell through such stores, and even Tandy created computer departments manned by trained salespeople within their Radio Shack stores. IBM quickly decided that their smaller computer would have to be sold by their authorized dealers.

The idea of upward compatibility from the small computer to the IBM PC or XT became an area of contention within IBM. Some argued that making the smaller, cheaper computer compatible would destroy the market for the simple floppy-disk-based PC. The other side believed that the true market for such a machine lay with business people who wanted to carry their work home. This required upward compatibility with the PC and XT computers. The result of this difference was a compromise that satisfied no one.

All of this went on behind a veil of secrecy that made a secret military contract look like a wide open door. The press knew that IBM was supposed to be working on a smaller computer, but aside from speculation the press really knew nothing about it. The PC had been given the code name "Acorn" (which came from the mighty oak,) and so the press gave the new machine, which was so tightly sheltered "underground," the name "Peanut."

As the date for the "Peanut's" release approached, speculation increased, and even the Wall Street Journal predicted that IBM would soon own the market for home computers as well as business machines. Ziff Davis had a promotional issue of PCjr Magazine ready to go, except for the press release from IBM, and had assigned Corey Sandler, Editor of PC Magazine, as Editor-In-Chief. Wayne Green, publisher of many computer magazines, had his "Peanut" Magazine ready to go. The stage was set for the great day.

Finally on Tuesday, November 1, 1983, in the Gallery of Science in the not-quite completed IBM building on 58 Street and Madison Avenue, in mid-town Manhattan, the show debuted. Admission was only by invitation which read "You are invited to a demonstration of a new IBM product."

As Editor-In-Chief of *Computer Shopper* since May of that year, I flew to New York for the occasion. I think I was only invited because of my former job as Technical Editor of *Computers & Electronics Magazine*. Arriving at the Gallery

IBM launched a huge ad campaign to insure "Junior's" success. As history now shows, it didn't work.

promptly at 9:30 AM, I was ushered downstairs where orange juice, coffee, and Danish pastries had been provided, and where the level of excitement among the assembled press was electric. Exactly at 10:00 a.m., the velvet rope was removed, and we swarmed into the next room where the long awaited "Peanut," now officially called "IBM PCjr," was on exhibit. At first, the room was illuminated by the flashes of camera strobes from newspaper photographers, who

probably did not realize the IBM would provide a complete press kit with lots of photos. The noise level of "OH's" and "AH's!" was deafening. Finally, when the uproar had died down, we all got a chance to visit the various booths where IBM's staff (complete with red roses,) were pre-programmed to answer our questions.

What we saw was a small oblong box with a single floppy disk drive and a couple of slots under the drive. The keyboard was connected to the system unit by an invisible beam of infrared light, and the keys were of a small, low, rectangular shape that gave rise to their description as Chiclets. The keys also had a distinctly spongy feeling when pressed. There was a color monitor which displayed excellent graphics with the demo software we were shown, and the system sported both a small thermal printer and a color ribbon printer. The thermal printer plugged into a port on the back of the computer, but the color printer required a special adapter attached to the computer on the side of the computer case.

When we members of the press started asking questions, we learned a lot that was not obvious at first. There were to be two versions of the IBM PCjr. The basic entry level model consisted of the system unit with 64K of user memory and 64K of ROM, an infrared keyboard, and a separate plug-in power transformer. This unit had two cartridge slots for IBM PCjr programs. There was also a connection for an optional, user-supplied, cassette tape recorder. Cassette BASIC was provided in the ROM memory. For video display, the user of a basic unit had to provide either a TV set or a video monitor and all necessary cables. The price for this entry level model was $669.

The enhanced model consisted of the system unit and keyboard, plus a slim-line 360K floppy disk drive. This model included an internal 64K Memory and Display enhancement. This card provided a 128K memory capacity and enabled connection to the optional, IBM Color Display. Other options included the serial thermal printer and joystick. The parallel printer adapter could be connected to the side of the case to permit the connection of a parallel printer. The price of the enhanced model was $1,269, without the video display.

The principal question in all our minds was "could the

PCjr be upgraded to run PC software?"

The answer to this question was, "Yes, and No." Yes, the PCjr would run the same types of software such as Easy Writer, VisiCalc, pfs File, pfs Report, Multiplan, and so on, BUT they had to be versions which would run within the memory capacity of the PCjr.

Another oft asked question was, "could a second floppy disk drive be added to the PC jr?"

The answer to that one was, "No, not now."

It seemed that the PCjr did not have a regular controller chip for the disk drive, but instead used the CPU for that purpose, and it could only handle one drive.

"Later," the IBM spokesman said, "an adapter would be added as an option, to permit a second drive."

The press also asked, "How much software is available on PCjr cartridges?"

The answer to that one was, "Only five games right now, but many software publishers are working on them."

Finally someone asked the "Emperor's Clothes" questions. "Why had IBM built a computer with such limitations?" "Why did IBM who is known for such excellent keyboards create the Chiclets keyboard?"

The answer to the first question was, "The PCjr was fully featured, with complete capability for its mission." The answer to the second question was, "We tested the keyboard with all our dealers and they all thought it was an improvement over other small computers."

The result of this introduction, believe it or not, was unqualified approval from most of the press. The dealers also saw the PCjr as a potential gold mine. The dealers saw the need for options as a chance to sell more equipment. They also saw the present lack of usable software as an untapped, unlimited, marketing potential.

Only a few of us doubters in the press saw the expensive PCjr as less capable than the Commodore 64, which sold for less than half the price and had a better keyboard. We were mainly the few writers whose publications did not have a vested interest in the success of the PCjr and had not gone overboard with our predictions.

Within a short time it became obvious that the public

agreed with us and in general was underwhelmed by the IBM PCjr. The majority of computer buyers were smart enough to realize that for slightly more than the cost of the crippled PCjr, they could buy a full-strength IBM PC from the gray market.

The complete lack of predicted sales quickly made IBM realize that something was wrong. The "Chiclet" name stuck to the keyboard, and the infrared connection did not work very well. Finally, IBM replaced the keyboards without cost to the owners and provided a connecting cable. They also increased the optional memory capacity to 500K, provided a second disk drive emulation, and an optional speech board.

Finally, in order to move the PCjrs out of the stores for Christmas, they put them on sale for $799 and included a color monitor free. At that low price, the PCjr really started to move. However after Christmas 1984, when the sale was over, the PCjr stopped moving for the last time. IBM had built about 350,000 units and the warehouses were still filled with them when the sale was over. Finally, IBM sold PCjrs to employees for less than cost.

In order to get a foothold in the educational market, which had been dominated by Apple, Tandy, and Commodore, IBM gave thousands of PCjrs away to schools, or sold them for educational purposes, at very low cost.

The failure of the IBM PCjr destroyed the myth of the "Home Computer" for the time being. Neither IBM nor any one else has ever given the general public a good enough reason why they need, or should buy, a computer for their home.

Without public demand for a product, it can't be shoved down the public's throat. However, during 1990 both IBM and Tandy have re-introduced home computers. This time, the machines are equipped with built-in software that appears to be useful in the home and with communications capabilities for on-line network services. They are also capable of both memory and hard disk expansion. It remains to be seen if the IBM PS-1 and IBM's more recent offerings can compete with the flood of cheap clones now available everywhere.

25 

COMPUTER MAGAZINES CREATED THE CHANNELS

Personal computer magazines existed before the start of the personal computer revolution. They started as newsletters that served to tie together the few hobbyists who were interested in using computers for educational and experimental purposes. Published by amateurs for a very limited audience, these newsletters nurtured the dream of personal computing.

A few hobbyists dreamed of actually owning a real operating computer, and they were members of The Amateur Computer Society started in 1966 by Steven B. Gray, the computer editor of *Electronics Magazine*. The newsletter of the ACS was published until 1976, by which time there were real computer magazines devoted to personal computers.

The first real personal computer magazine was *Creative Computing*. Started by David Ahl in 1974, *Creative* was mainly devoted to educational and recreational uses of minicomputers until the first microcomputers were developed. Dave Ahl, a former DEC employee, had tried to promote the personal use of DEC's small PDP-8 computers but was shot down by Ken Olsen, President of DEC, who said, "I can't see any reason why anyone would want a computer of his own."

Soon after that, Ahl left DEC and became the Education Marketing Manager of AT&T, starting *Creative Computing* as an outside activity. With an initial press run more than ten

times the number of subscribers, Ahl used *Creative Computing* itself as promotional material, selling issues where he could. However, with the launch of the Altair 8080 computer, interest in personal computing exploded, and *Creative Computing* rode the crest of the wave. When I opened Computer Mart of New York in 1976, Dave sent me large bundles of *Creative Computing* to sell, and he would personally replenish my supply whenever he came into New York City.

At first, there were no advertisers in *Creative,* but as small companies started to sell software and peripheral boards for Altairs, IMSAI, and SWTPC computers, they looked to the few computer magazines as a means of reaching potential customers. With only a handful of computer stores in the country, most manufacturers sold direct and relied on ads to move their products.

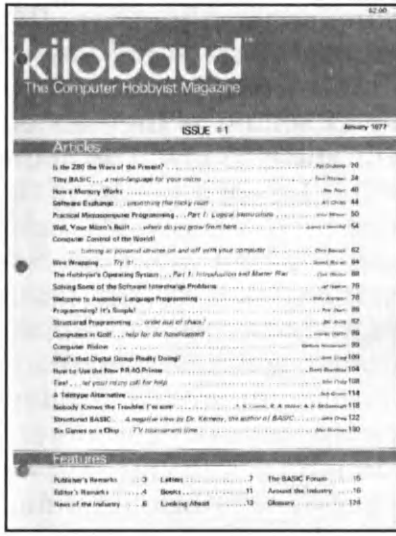
In 1974, *Radio Electronics Magazine* published the plans for the Mark 8, a computer based upon Intel's 8008 processor. However, there was no company ready to offer complete kits to the few hobbyists interested in building the machines. There was also no software and few supporting peripherals.

By 1975, everything changed when the Altair Computer appeared on the January 1975 cover of Ziff Davis' *Popular Electronics Magazine*. The Altair was offered as either a set of plans, a set of PC boards, or as a complete kit with all kinds of peripherals and software offered "in the near future." A real company, MITS made the offer, and although it took some time, MITS made good on the promises. The personal computer industry was born.

What the head of MITS and the designer of the Altair, Ed Roberts, gave the industry was an 8080 computer with a standard bus design. The Altair could be purchased with a minimum configuration and could be expanded by inserting additional expansion boards. Ed Roberts also contracted with Bill Gates to provide software that would run on his computers and on any others of the same basic design.

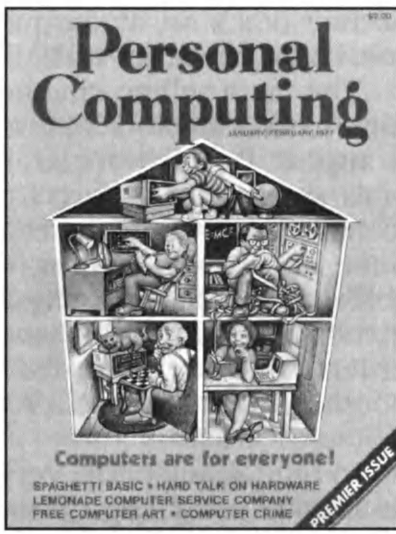
In September 1975, *Byte Magazine* published its first issue. With Carl Helmers Jr. as Editor, and such notables as Don Lancaster, Hal Chamberlain, and Dan Flystra as contributors, *Byte* was a success from the first issue. Wayne Green, the

First issue *Byte*, Sept. 1975.



First issue *Kilobaud*, Jan. 1977.

publisher, was no newcomer to the publishing industry, and he recognized the necessity for advertising. In fact, the readers were as much interested in locating sources for computers and parts as they were in reading the articles.



First issue *Personal Computing*, Jan./Feb. 1977.

With a working, practical computer bus and supporting 8080 BASIC from Microsoft available, other S-100 computers besides the Altair appeared. The IMSAI from IMS Associates, the SOL from Processor Technology, The Polymorphic, and the Cromemco all used the same bus and expansion boards that were interchangeable. Application programs written in dialects of Altair (Microsoft) BASIC were developed for sale. All of this required access to the customers, who were thinly scattered across the country. Most of the

manufacturers turned to the magazines to sell their products because there were few stores carrying microcomputers. They had to sell direct if they were to sell at all. A few stopped direct selling as they acquired dealers, but even then they continued to advertise in the computer magazines to sell the public on their products.

By 1978, many new computer magazines appeared. *Personal Computing, Kilobaud, Interface,* and *Dr. Dobbs* were on the market. Others, like *MicroTeck* or *ROM,* appeared for a few issues and folded, either because they were underfunded or did not find reader acceptance. At that time none of the computer magazines were machine-specific because no one make of computer dominated the industry. To get enough advertising to survive, the magazines had to cover all types of personal computers. They even covered some that never existed. Several magazines carried a particular color ad showing a cat on their rear covers. The ad was from a computer company who described all the wonderful features of their machine, a computer that would be available "real soon now." It never was.

The main selling channel was direct from the manufacturer to the customer, although more and more stores started to appear. People were so anxious to get computers, peripherals, software, and parts from suppliers that they were glad to mail money to advertisers able to supply their needs. Many a computer manufacturer, with not more than an idea, were able to place an ad in a magazine and receive a flood of money in the mail. They could then afford to buy the parts to fill the orders. Under these conditions, some abuses took place, and people lost money to crooks who promised much and delivered little.

In time, some of the very manufacturers who had gotten their start by selling direct turned exclusively to dealers. Apple was one of the first companies to sell through dealers exclusively, but their market share was not as large as all of the various S-100 computers that dominated the market with floppy-disk-based computers running under the CP/M operating system. CP/M Computers were sold through stores, VARs, and through the direct channel.

As the market grew, so did the number of magazines that

competed for the growing population of computer-owning people, as well as those who were just becoming interested in personal computing. There were magazines devoted to the S-100, CP/M-based computers, others for the Apple II and Apple III market. Commodore computers had their share of magazines, and several supported the popular Atari computers. Tandy TRS-80 computers were supported by some of the largest and most popular computer magazines. Even the little Sinclair Z81 boasted several supporting magazines. As soon as a new computer was announced, at least two supporting magazines were also announced. The bubble kept getting bigger and bigger and bigger; soon it had to burst.

In 1981, IBM announced the PC and soon started shipping. Distribution was through selected computer stores and through IBM Computer Centers. The demand for PCs and later, XTs, far exceeded the supply at first. Then, as IBM ramped up production, the machines flowed out of the authorized channels into the so-called Gray Market. The direct marketeers obtained a large share of the gray market PCs and started to drop sales of CP/M based machines in favor of PCs.

The Computer Shopper, born in 1981 as a trading paper for used computers, evolved by 1983 into a tabloid magazine devoted to direct sales of computers, peripherals, software, and computer parts. It covered all makes of computers, and because of its sectionalized make-up it was able to shift quickly as the popularity of the various types peaked and then waned. *The Computer Shopper* became the primary advertising medium for small start-up companies who sold direct to the end user. The birth of the PC clones gave these direct market start-ups the chance to sell products that were greatly in demand. Many of the small PC clone suppliers grew to become major manufacturers, and their ads swelled the *Computer Shopper*, which soon became one of the larger magazines in the industry.

The birth of the IBM PC/XT/AT and the rise of MSDOS PC clones proved to be the breaking point for machine- specific magazines devoted to CP/M and TRS-80 computers. Most of them were swept away in 1984-1985, with the TRS-80 magazines holding on until Tandy became a major builder of

MSDOS machines. A few Commodore and Atari magazines survived in a greatly reduced form. The Apple II magazines also were largely replaced by Macintosh magazines. The greatest growth came about in the MSDOS-OS/2 magazines which completely dominated the field. Even such general computer magazines such as *Byte* and *Computer Shopper* are largely devoted to MSDOS.

The direct channel, having been carved by magazines, continues to grow and has spread from the Computer Shopper to other magazines. Most manufacturers today seek sales in all marketing channels, and even large corporations are seeking the savings and rapid delivery available in the direct channel.

26

THE COMPUTER SHOPPER: From Yellow Rag to Major Magazine

During the time I was in the retail business, I subscribed to a newsletter for selling used computers. It was called *ON LINE* and did not last for very long. It was bought out by Glenn Patch, Publisher of *Shutterbug Ads*, a highly successful tabloid for used and collectible cameras. Glenn changed the name to *Computer Shopper* and started publication in 1981.

Since my name was on the subscription list, I received a copy of the new publication. The *Computer Shopper* was mainly columns of classified ads for computers, peripherals and software for sale–mainly used. However, there was a column of editorial material describing several computers. I thought it was terrible, and I wrote to Glenn Patch and told him so. His answer was, "if you can do better, go ahead and do it." So I started writing a column entitled "Veit On Computers." I didn't get paid much, but it was my own soapbox because they printed everything I wrote. It was fun.

Then, in 1982, Glenn asked me to come to Florida and talk with him. I went and he told me that he intended to expand *Computer Shopper* and go for Second Class mailing privileges. To get this, he had to have at least 25 percent editorial matter. He wanted me to become Editor-in-Chief and run the magazine. Although I liked Glenn and the people who worked for him, I was not ready to leave my life in New York, my wife, and my job at Ziff Davis to go to some small Florida town.

Then things changed at Ziff Davis. *Popular Electronics*

became *Computers & Electronics*, and I was told that they wanted me to stop writing and mainly do editing of other people's stuff. I was not happy at this and I told my boss, Art Salsberg, "I am mainly a writer and that is what I want to do."

"You don't have any choice," was his answer.

That was like waving a red flag in front of a bull. "Yes I do," I said, "I can quit."

I called Glenn Patch and accepted his offer. Then I gave notice. In a few days, I was called into the office of Larry Sporn, president of Ziff Davis Publishing. "What's this I hear about you going to some damn yellow rag in Florida," he said. "Are you out of your mind? You don't have to do this, I like you."

I thanked him but told him that the chance of running a magazine was too much to give up, and that I was gone.

I left New York, Ziff Davis, and Dede at the end of March 1983 and went to the National Computer Congress at Disney Land in Anaheim, California, with more than a little apprehension. Glenn had rented me a furnished apartment in Titusville, and when I finished at the NCC and a side trip to show the flag at a big Swap Show in San Jose, I would come to Florida and take over the *Shopper*. Gary Liput, the *Shopper*'s marketing manager, was to meet me at Disney with Linda Rew, who was in charge of *Shutterbug Ads*, Glenn's photography magazine. Linda was on her way to a photo show, and she would spend a few days with us before her show started.

This was the NCC where many of the exhibits were in tents, where the temperature reached 110º and fried many of the computers, to say nothing of the people working in the booths. It proved to be the end of the NCC as a national computer show. Most of the small computer companies moved their exhibits to Comdex and the National show died.

Gary and I arrived back in Titusville on a hot Sunday, and Gary drove me to the Imperial Towers where my apartment was. What a letdown. The place was a real dump, and the apartment smelled from mildew. I was more than a little upset.

"Where does he think I came from, that I would live in a place like this?" I complained to Gary.

"You don't know Glenn. He probably never saw the

By 1988, Computer Shopper was billing itself as the "World's Biggest Computer Magazine." It's certainly too big for our scanners!

place–just took someone's word for it. Glenn was trying to help you," Gary explained.

So I checked into a motel and waited for Monday.

Once I arrived at the office, I plunged into work and forgot about leaving. I had an issue to get out. Everyone expected to phase into a newsstand issue and increased editorial over the next few months, but Glenn had different ideas. He announced that we would go on the newsstand by the June issue. That was the next issue, and we better get moving. Luckily, I had plenty of editorial material as a result of attending the shows, and the salesmen had signed up quite a few new advertisers. The new *Shopper* was born with that issue.

Glenn also wanted to boost subscription circulation with a soft subscription offer. In the magazine world, a hard offer is one in which the new subscribers send in their money in advance. A soft offer is a try-it with no obligation to buy. In other words, the subscriber orders the magazine and gets the first issue. Then a bill is sent. The subscriber either pays it or

cancels it without any further obligation. It is a way to get people to try a new publication, but it is a crap shoot gamble. We were going to send out 50,000 pieces of mail with this soft offer. It was up to me to produce an issue that would persuade people to want more of the same. I was confident until I started to see the typeset copy, and then I freaked.

Glenn had a policy in the *Shopper* which he called "controlled sloppiness." This meant that the way the classified ad was set was the way it ran. Never mind typos, or ads cut in half, or missing words. This made sense in a publication that contained nothing but classified ads. Chances are the item would sell anyway, and if the advertiser complained, they would just re-run the ad next month for free. Now, I found out that production was doing the same thing with my articles! I raised hell and made them re-type the text until they got it right. Production went to Linda Rew, who had been promoted to Assistant Publisher and complained that the new Editor was keeping them from getting the issue out on time. Linda came to talk with me, and I told her that they had to do it correctly. I would not tolerate "controlled sloppiness." We ended up screaming at each other, and she went away. Next Glenn's wife, Patti, came to talk with me. I told her that her husband was going to send out 50,000 copies to people who did not have to pay if they did not like the magazine. I was not going to send them garbage with my name on it.

So they went direct to Glenn. He listened, and told them they better do it the way Stan wanted it. The fight was over, and somehow we got out the issue with a minimum of typos. I never had to fight that battle again.

The *Computer Shopper* grew because we gave the readers unbiased information. None of the big manufacturers advertised with us, so we could call a spade a spade and pull no punches. I sectionalized the book so there was something for all computer users. At a time when computer magazines were becoming machine-specific, I took the opposite tack.

My son-in-law, Larry Morrisette, came to work on the *Shopper* as a salesman. With Gary Liput, Ken Wood, and Larry, we had a sales staff that was truly dedicated to helping the small mail order firms that advertised with us. These

salesman did more than take orders for ads; they acted as free marketing consultants for their customers, some of whom had only recently arrived from the Orient. The more ads we ran, the more we grew. Soon, the *Computer Shopper* was over 300 pages and still growing.

The first page was a table of contents, and I wanted to have covers like slick magazines. Glenn opposed this, saying he wanted to book to keep its "cheap" identity and that I was on an ego trip. Came the Christmas issue, I dressed our production manager as Santa Claus sitting in front of a computer and photographed him for our first cover. I got away with it because it was Christmas. The next month I used Glenn's youngest daughter as a model on the cover. Our salesmen also sold the back cover and inside cover pages for premium prices. That was the clincher; we had covers from then on. However, we still ran advertising banners under the cover art. We made money out of everything we could. If we could have sold ad space on the spine, we would have.

Eventually we grew more, got real covers, perfect binding, and the magazine became thicker with each issue.

The marketing vastly improved when Dick Govatski, originally from Ziff, came on board as Group Publisher and Burrell Patch, Glenn's brother, became president. We hit over 600 pages and our profitability was the envy of the industry.

Dick Govatiski convinced Glenn that he should back a new weekly Macintosh paper to be published on the West Coast. I advised against it because although I thought it would eventually make money, there were not enough potential ads to support it at that time. In addition, David Bunnell of *Computer World* and *Mac World* was also planning a weekly Mac paper. There was certainly not enough business for two weeklies. Bunnell had the support of Apple and the money of Pat McGovern's highly successful IDG Company. It was tough competition. Our Mac Week came out first and it was a much better publication, but that wasn't enough.

Both publications were losing a lot of money with every issue, and it was particularly hard on Patch Communications, which did not have the resources of IDG. However, Glenn Patch was determined to stick it out because he could not

afford the loss of investment. IDG, on the other hand, could spread losses over their world-wide publishing business. Glenn Patch could have sold *Mac Week*, but the offers were not good enough to compensate for all the problems he had gone through. However, all the suitors were really not after *Mac Week*, but the cash cow, *Computer Shopper*.

Finally, with the prospect of continuing losses from *Mac Week*, Glenn decided to accept the offer of Ziff Davis to form a limited partnership with Ziff as the general partner and Glenn Patch as limited partner. With Ziff Davis in the picture, Pat McGovern realized that he could no longer bring pressure on *Mac Week*. He did not like money-losing magazines, and IDG decided to fold their weekly Mac paper. This left the field to *Mac Week*, but it still did not eliminate the losses—only the growth of the Mac market could do that. In the spring of 1988, the partnership, Coastal Associates Publishing LP, took over *Computer Shopper* and *Mac Week*. A year later, *Computer Shopper* was moved to New York.

When negotiations were underway with Ziff Davis, Glenn told me that my contract with him was a problem since it named me as Publisher/Editor-in-Chief for an indefinite period. I assured Glenn that I was perfectly willing to renegotiate my contract. If Ziff took over the magazine, they would want their own people to run it. Upon coming to agreement with Ziff, I stepped down as Publisher but remained as Editor-in-Chief until they found a suitable replacement. Then I became Editor-in-Chief Emeritus.

27 UNCLE SOL'S TOYS

Leslie Solomon, often called Les, or "Uncle Sol" by his many friends in the computer industry, is considered by many to have had a major influence on the early development of the personal computer. As Technical Director of *Popular Electronics Magazine,* which at the time was Ziff Davis' only electronic publication, Les was the point man charged by Editor Art Salsberg with bringing in interesting electronic projects.

Popular Electronics had scored important firsts such as an early laser communication system project and a video/computer breakthrough with the publication of Don Lancaster's "TV Typewriter," a device that put text on a TV screen from an ASCII keyboard. The next logical step was the publication of a project for a home-built computer. In 1973, few people could even imagine such a thing, but Les Solomon has one of the most vivid imaginations of anyone I have ever met. He seems to see far ahead and around corners into the future. Perhaps that is why he was so successful in his job.

He came from very humble beginnings–an orphan home in Brooklyn from which he was farmed out to foster homes. Growing up, he had an intense interest in science, particularly in electronics and aviation. Becoming a young man upon the U.S. entrance into World War II, he enlisted in the army. Shortly after basic training he was singled out, because of his intelligence and his orphan status, to train as a member of the newly formed OSS. After undergoing vigorous training, he

became part of a team dropped into occupied Holland to work with the Dutch underground and to radio details of the German occupation back to England.

When the war ended and he was discharged, Les went to Palestine as radio operator aboard one of the ships seeking to transport survivors of the Nazi death camps to Israel. When his ship was blown up by the British, Les joined the Jewish army fighting in the Israeli War for Independence.

His adventures during this period would make an exciting adventure book, but that is not what this history is about.

Returning to the United States, he found that he had been awarded a scholarship by the Dutch government for his work in Holland. Taking advantage of the G.I. Bill and his scholarship, Les attended the University of Lyden in Holland, where he studied electrical engineering. Upon his return to the United States, he went to work as an engineer for General Electric. With his imagination, technical ability, and love of tinkering, he soon was writing articles for electronic magazines, and he eventually left G.E. to return to New York City, where he became a staff editor on Ziff Davis's *Electronics World Magazine.* Later he joined the staff of the new *Popular Electronics Magazine.*

By 1973, transistor integration had proceeded to the point where electronic calculators and watches were commonplace and micro-controllers were used to create computer-like circuits. The stage was set for the development of the computer microprocessor. Minicomputers such as the DEC PDP-8 had shrunk to desktop size, but being constructed with discrete transistors they were much too expensive for home or even most office use.

All of the electronic magazines were searching for computer projects to present to their readers.

Popular Electronics Editors Art Salsberg and Les Solomon were working with a writer named Jerry Ogden to produce a design for a training computer to teach the principles of digital computing. However, when *Radio Electronics Magazine* published Jonathan Titus's Mark-8, 8008 computer construction project, they realized that their trainer project was too little, and too late. *Popular Electronics Magazine* had to find a better computer project.

On a trip out West, Les had visited Forest Mims, one of *PE*'s prime authors. Forest introduced him to Ed Roberts, who was the principal in a company that Forest was interested in. The result was a project to build a digital calculator designed by Roberts' company, MITS. The calculator project was very successful, but soon after it appeared, calculators from Japan were on the market, selling for far less than the parts kit for the MITS project.

At a meeting, Les Solomon and Ed Roberts discussed the construction of a home-built minicomputer. Les suggested that it be powered by the recently developed Intel 8080. This new chip was a complete microcomputer CPU with a fairly complex instruction set. One problem was that the 8080 sold for too high a price to use in an a magazine construction project. Ed Roberts was able to get around this problem by obtaining a supply of cosmetic reject chips for less than 1/3 the retail price. Ed Roberts then designed the computer, that was intended to sell for about $400 in kit form. It had a front panel with lights and switches and was housed in an attractive Optima cabinet to meet Art Salsberg's requirement that the computer be attractive as well as practical. Most important, the PE-8, which was Robert's name for his computer, had an open bus that provided for future expansion. This project was just what *Popular Electronics* was looking for, and it was featured on the cover of the January 1975 issue of *Popular Electronics Magazine.*

Finding the name PE-8 too dull, Les Solomon re-named it the Altair 8080.

There are a dozen stories about how the name was selected, but I like the one where Les' daughter named it Altair after a planet in Star Trek.

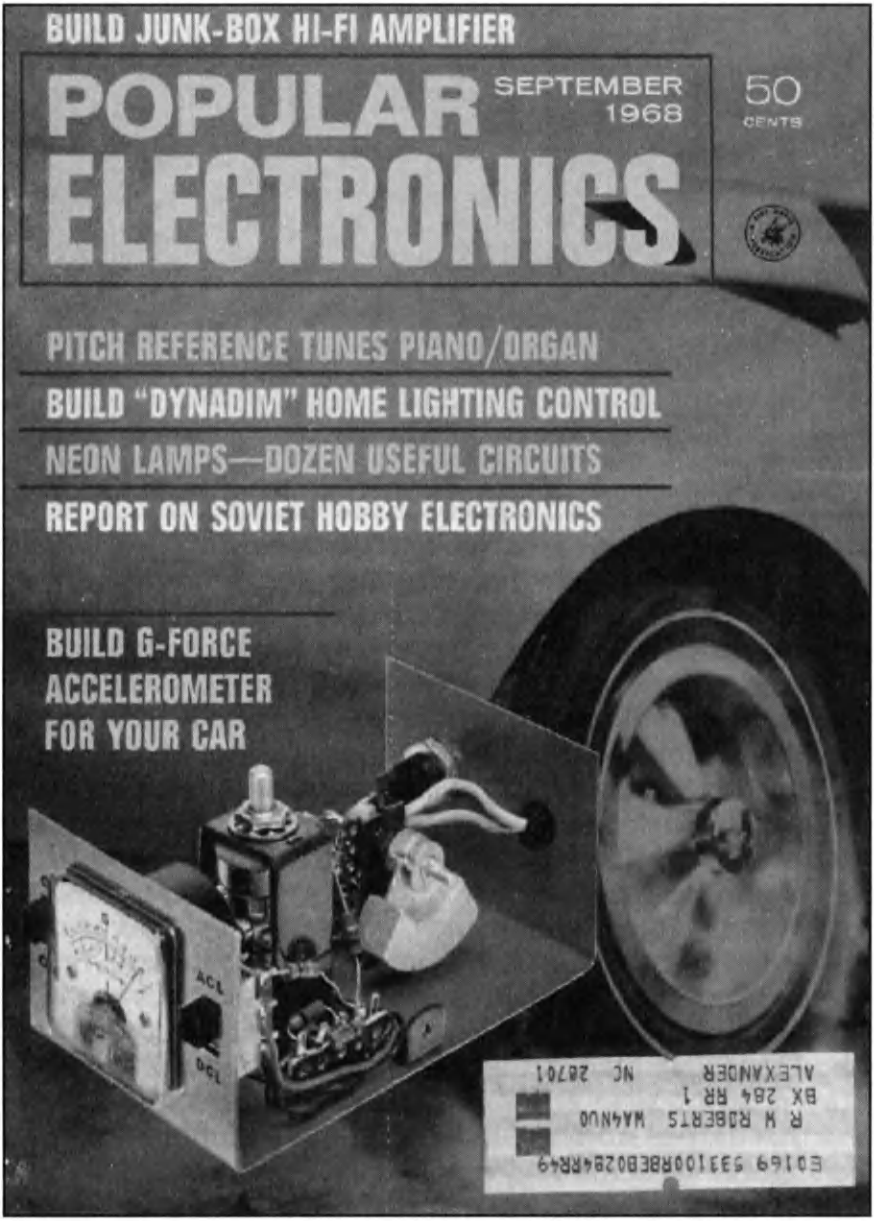
Ed Roberts shipped the first Altair to New York via Railway Express Company, just as the company was slipping into bankruptcy, and it never arrived. The unit shown on the PE cover was a non-working dummy computer, but Ed Roberts quickly built another working model and shipped it to New York.

The success of the Altair became the spark that ignited the personal computer revolution, but there were many pieces missing. The principal missing link was a practical low-cost terminal. To remedy this, Les made another trip West. He

introduced Don Lancaster to Ed Roberts, in hopes of having them work together to provide a video terminal. The meeting was a disaster. Don and Ed were two strong-willed, opinionated men that mixed like oil and water. Don Lancaster did develop such a low-cost video terminal, but it was not used as one of the Altair computer's peripherals.

At One Park Avenue, Les kept his Altair and an ASR-33 Teletype in his little office at *Popular Electronics Magazine*. The teletype made a terrible noise, disturbing everyone on the magazine until the magazine publisher told him to "get that THING out of there." So Les carted the computer and Teletype home to his basement workshop where he created a set-up that became a Mecca for the emerging computer industry. The entire "who's who" of personal computers visited Les's basement when they were in New York, including Roger Melen and Harry Garland of Cromemco, who designed the Cyclops video camera, the ByteSaver EPROM board, and the T.V. Dazzler board, which became projects published in *P.E.*. Bob Marsh and Gary Ingram of Processor Technology came and brought their Altair expansion boards, and later the SOL computer. Lee Felsenstein, who designed the Pennywhistle Modem for *P.E.,* and later the SOL and Osborne Computers, was a frequent visitor. Steve Jobs and Steve Wozniack, who came with the Apple I and II computers, gave "Uncle Sol" one of the first Apple II computers. In addition, they were followed by an endless stream of computer notables.

Les finally got his 8080-based terminal a year later in 1976. Gary Ingram and Bob Marsh of Processor Technology had been developing Altair/Imsai-compatible expansion boards as the foundation of their business. These included the 3P+S I/O Board and the VDM-1 Video board. To make a terminal, all that was needed was a keyboard attached to the 3P+S for input and a CRT connected to the VDM-1 for video output. Les solved part of the problem by taking a TV set and gutting the RF section. Then he made a few changes to the video circuits, put the thing into a wooden box, and he had a low-cost video monitor. He then proposed that Processor Technology design the much-needed terminal, using their boards and his video monitor idea. However Processor Tech had



Les Solomon was the Technical Editor for *Popular Electronics*—for many years the world's best-selling electronics magazine. The readers of "Pop 'Tronics" were hobbyists and ham radio operators; people who took to personal computing like ducks to water when computer kits appeared in the mid-1970s.

Processor Technology's Sol computer was named after Uncle Sol.

more ambitious ideas. The Processor Technology partners hired Lee Felsenstein to complete the design for a complete 8080 desk top computer.

Lee's design used the existing board circuits mounted on a single motherboard, but he added an 8080 CPU and a horizontal rack for additional expansion boards. He also introduced the concept of "personality modules" that would convert the machine from a dumb terminal to a smart terminal, to a complete, powerful, 8080-based computer. Bob Marsh designed an attractive typewriter-style cabinet with walnut side pieces.

Popular Electronics eagerly accepted the article on building the Processor Technology machine. There was just one little problem with the project. The same publisher who had asked Les to get rid of the Altair had also issued an edict. "No more computers in *Popular Electronics Magazine.*" However that did not stop Art Salsberg and Les Solomon. They put the Processor Technology machine on the cover and ran the construction article in several parts, but only offering the terminal version, calling it "The SOL Intelligent Terminal."

The crew at Processor Technology had named it for Les Solomon saying, "If it works, we'll say it's named for the Sun. If it don't work, we'll say it's named after Uncle Sol."

After the Altair, the SOL was the most popular computer

project that ever appeared in *P.E.* However, there were many others such as The Pennywhistle Modem, the Heuristics Speech Recognition Board, the T.V. Dazzler, and Steve Dompier's two-chip Music Board for the SOL.

I became close friends with Les Solomon when I opened The Computer Mart of New York a few blocks from his office at One Park Avenue, and he would visit my store during his lunch hours. One day he came in to show me a contraption he had built with an RCA 1802 CPU. He was fascinated with this chip because of its extremely low power requirement. Inside a little box, Les had built a little computer powered by two wires stuck into a lemon. While designing a project for the magazine using this chip, he had kept decreasing the power to see how little he could keep it running on. The lemon battery represented absolute minimum.

Our friendship lead to collaboration on one of the first personal computer books for beginners, *Getting Involved With Your Own Computer*, and it became a best seller.

I have fond memories of working with him in the famous basement computer workshop. The first time you went downstairs, Les would flip a hidden switch. This would turn on the SOL.

As he came into the workshop, Les would say, "Good evening, SOL."

A speech board in the computer would answer, and the words would also appear on a 19" converted TV. "Good evening Les–are you ready for work?"

Boy, would this get your attention! In those days computer speech was something few had ever heard!

Then Les would show you the Altair, the Apple II, and the South West Technical M6800 computers set in shelves around the workshop. In the corner was an electronic organ, with a full console, he had built from a kit, and he had a Heathkit short-wave radio receiver, stereo FM receiver, and a big reel-to-reel tape recorder. I never had seen so much electronic equipment in a private home.

Soon after the publication of our book, Les's wife Beverly was stricken with cancer, and he devoted himself to her care through a long and fatal illness. While he remained as Technical Director of *P.E.*, there were not many breakthrough

computer projects such as the Altair and the SOL. The industry had grown into an evolutionary phase, and *Popular Electronics Magazine* had grown away from its leadership role in computers.

I joined the staff of *Popular Electronics* in 1981 and became the first person to hold the title of Computer Editor. In 1982, *Popular Electronics Magazine* was converted into *Computers & Electronics Magazine.* Les was assigned one more "glory story" when Heathkit developed the Hero 1 Robot kit. He went out to Heath and spent a week with Hero learning all about the Robot and writing his story. When the Robot was shipped to New York for cover photography, Les and a group met Hero at the airport. The photographer took a fantastic photo of Les and Hero touching fingers with a spark, just as in ET.

Les Solomon retired from Ziff Davis in 1984, and, except for some excellent video articles he wrote for *Computer Shopper Magazine,* he has done little writing. Remarried, he devotes most of his time to his family and traveling. Now, however, he has become deeply interested in Chaos mathematics and Fractals, creating all kinds of video fractal creations on his computer. We may yet hear from him again.

28

BREAKING THE THOUSAND DOLLAR PRINTER BARRIER

An historic moment in the personal computer world occurred during 1990, but very few people noticed it or marked it down for posterity. The laser printer price level broke the $1,000 barrier for the first time. Possibly only the sharp direct buyers who read *Computer Shopper* took a second look and said, "Now I can get one to use at home!" However, when I saw the demise of the One Grand Barrier, I remembered the previous great event when the impact dot matrix printer price first broke this same price barrier.

When the very first personal computer kits were offered for sale, they sold for around $500. Of course, you had to add options that usually brought the price to around $700 or $800, but even then there was still an expensive missing link that no one told you about. There was no way to print hard copy! Excuse me–there was no way to print hard copy that you could afford.

The device that was most often used by computer owners, including most commercial installations, was the Teletype®. The wonderful ASR-33 Teletype® served as a printer, a data input device, and even the computer memory. It printed at 10 cps with great noise and much movement of rolls of yellow paper, but you could clearly read its output. The attached tape punch and tape reader was used to load the computer with programs and to make new tapes of the computer output. You could even use it to duplicate tapes without going through the computer. One of my most valued

possessions is one of the first tapes of Altair BASIC sent to *Popular Electronics Magazine* by Bill Gates.

The only problem with the Teletype, besides its infernal noise, was its price. A new one cost about $2,000, and they were almost impossible to get. Teletype Corporation sold them for about $1,700, but you had to buy them a year in advance, so they were sold on the "gray market" for way above their factory price. A re-built ASR-33 could be bought for $1,200, and they were not easy to come by. MITS Altair had made a deal to offer ASR-33 Teletypes to its customers for $1,500 without an interface. You had to buy the Altair interface board to use it, but it was still a great deal. Hobbyists often bought real old junker Teletypes that used Baudot code and wrote special conversion programs to convert the Baudot code into ASCII.

Real computer printers were so far out of reach of personal computer users that they were not even thought of in conjunction with microcomputers. Before I became involved with personal computers, I worked for a company that made computer printers. We made drum printers, and they were considered to be very low in cost. We had an 80-column, 150 line-per-minute printer for $10,000! So by contract the teletypes were really cheap.

Into this situation came South West Technical Products, who had already made history with their M6800 computer and their low cost CT-1024 Video Terminal. SWTPC imported a printer mechanism that had been developed for cash registers and could print 40 characters on a roll of cash register paper. It used a 5 x 7 dot matrix print head, which it moved by means of a rotating cylinder with a spiral key way. The PR-40, as it was called, had a one line, 40-character buffer memory and could print the 64-character ASCII upper case set. The printer was only offered in kit form, but the mechanism was completely constructed. The price for this little wonder was only $250, and for a long time it represented the only cheap printer for the microcomputer user.

The next company to try and produce a low cost printer for the hobbyist was Integral Data Systems. They brought out a 7 by 9 dot matrix machine called the IP-225 Brighter Writer for $949. It could print a 96-character set on any width paper

up to 8 1/2" wide. It also came with either a serial or parallel interface and had such modern features as a line feed button and a self test button. The IP-225 was driven by rather complicated software, and very few users were able to make it do all of the things the makers claimed for it. It was also subject to mechanical failure when it was used too much. For most people, the IP-225 was not a solution to the printer problem.

The primary company in the dot matrix printer business at that time was Centronics. They made real heavy-duty computer printers that were used by most of the minicomputer manufacturers for applications requiring speed and long print runs. At that time, a user had to make a choice between speed and quality. If speed was necessary to print long reports, or thousands of labels, you used a dot matrix printer. If you had to have quality printing, you had to use a solid type machine using a daisy wheel. The dot matrix printer could operate at 300-600 characters-per-second (cps) while the daisy wheel machine's top speed was 30 cps, and many of them only could only type at 10 or 20 cps.


Centronics already made large printers.

The Centronics dot-matrix printers were sold at $2,000 to $6,000, depending on the features included with them. The daisy wheel machines sold for around $3,500. Line printers sold for over $10,000.

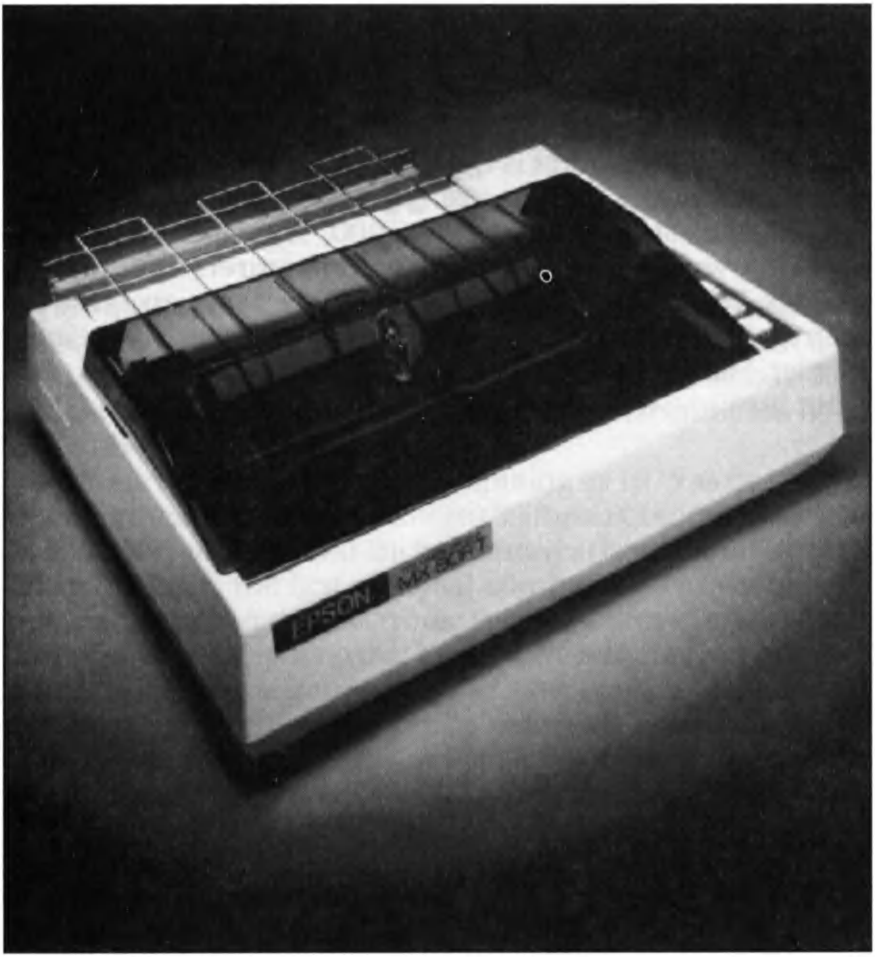
In 1978, as more and more personal computers came into use, Centronics saw that there was a po-

tential market for a low cost, industrial-strength printer that could be used with the new personal computers. They developed a stripped-down model called the Model 779 and priced it at less than $1,000 with friction feed if you bought more than one machine. However, it still cost about $1,200 in single quantities. The Model 779 became the most widely used printer ever made up to that time, and Centronics reduced the price so that it became the first real computer printer to break the $1,000 price barrier. It became popular just at the time floppy disks were replacing cassettes for data storage, and just at the point that microcomputers were being used for real business applications.

However, the popularity of the Model 779 soon inspired competition from overseas. The Japanese had selected computer printers as their entry point for low-cost computer peripherals. The Epson Model 70 first appeared in 1981 and sold for only $600. It was a rather poor printer of sheet metal construction and unreliable electronics, but it was cheap, and it did print 80 columns of ASCII characters at a rate of about 60 cps. People bought them in spite of their defects. Soon, Epson learned how to make a reliable printer to sell at a low price and withdrew the Model 70, replacing it with the Model 80.

The new printer was the perfect machine for the market, it was low in cost, and it was reliable. It could print both upper and lower case characters at 80 cps and was available with tractor feed for a slight extra cost. The $1,000 barrier was not only broken, it was smashed–flat. The Epson printers were so good that when IBM created the IBM PC, they selected it as the PC Printer, only adding some extra characters to the print set. Epson then offered the same printer as the MX-80, the most popular computer printer ever built.

From that time on, computer printers kept improving and the price kept going down. The manufacturers learned how to pack more pins into the print heads, and soon 9-pin printers became the standard, replacing the 7-pin models. The users were also given a choice of high speed 120 to 180 cps, in dot-matrix draft output, or 60 cps in Near Letter Quality (NLQ) printing. The NLQ was so good that high-cost daisy wheel printers became almost obsolete for most appli-



The Epson MX-80 series became the most popular printers every built. For years it was the standard type of printer for IBM PCs.

cations. As the print heads on the dot matrix printers improved, first offering 15 pins and then 24 pins, the letter quality also became better, and it became possible to offer a variety of printing fonts. Soon, daisy wheel printers which had sold for $3,500 were being offered for less than $1,000 and finding few takers. In addition, the dot matrix printers became capable of printing graphic images and color.

Finally, Canon combined laser electronics with the electrostatic plain paper copier and produced the Laser Printer

used by Apple and Hewlett-Packard. In spite of their high cost, laser printers became the new standard of quality. They could not only produce letter quality, they could print with typeset quality and with a variety of fonts and graphic images. Today, the laser printer is the most desired peripheral on the market. Only the higher cost has prevented their universal application. Starting at over $6,000, the laser printer has come down in cost as more manufacturers entered the market. While laser printing will never be as cheap as the dot matrix printer, it has finally broken through the "One Grand Barrier," and no one knows how little it will cost a few years from now.

Appendix

A REMEMBRANCE OF GEORGE TATE

With the purchase of Ashton-Tate by Boland International, another pioneer company may pass into history and with it all trace of my late friend George Tate. As one of the swashbuckling founders of this industry, he deserves to be remembered by at least a chapter in this history.

George started in personal computing in 1975 as one of the founding members of the Southern California Computer Society (SCCS). George and friend Michael Shrayer (later author of "The Electric Pencil," the first personal computer word processor) would scrounge in the electronic surplus stores in and around Los Angeles, buy anything that looked remotely like a computer, and sell it at computer club meetings. One time they struck gold in the form of 50 junked Burroughs Terminals. Out of the batch, George Tate managed to piece together about 30 terminals that worked in the local mode. Nobody tried them on line because nobody knew how to interface the terminals. George was amazed that the club members still bought them, but even more amazing was the reputation George got of being a wizard at repairing computers.

When John French opened The Computer Mart of Los Angeles in 1976, he asked fellow club members to recommend an expert technician. George Tate was recommended, so John French hired him as his computer repair and construction technician. What George didn't know he learned on the job.

At that time I owned and operated the Computer Mart of New York, which I had started slightly before the founding of the Computer Mart of Los Angeles. John French, George Tate, and I became friends over the transcontinental telephone. Because we were all feeling our way in a brand new industry, we had a lot to learn from each other.

George Tate had a flair for marketing. Instead of keeping

to himself in the back room, as most technicians do, George let French put him into a full-page *Byte* magazine ad as "The Computer Doctor," complete with white doctor's coat. This made George a celebrity, as well as an instant expert.

In those days, all the IMSAI computers we sold came only as kits, and they were not easy to assemble. Few buyers could assemble one and make it work. We could not make much money on IMSAI kits, but people were willing to pay a premium for assembled machines. George Tate hired a bunch of computer club members and set up a "factory" to assemble IMSAI computers. I did the same in New York, but George could do it better and cheaper. So I, three thousand miles away, had my "factory built" computers put together by George's crew at the Computer Mart of Los Angeles and shipped to me in New York City. With this supply of IMSAI computers assured, both computer stores grew very rapidly.

Dick Wilcox, who worked for Western Digital Corporation, came to John French with an idea. Western Digital was in Chapter 11 at that time, but Dick Wilcox said he could reprogram the WD-16 CPU Chips that Western Digital had made for the DEC PDP-11 computer. His new version of the CPU would work in an IMSAI and give that computer all the abilities of a minicomputer. John French gave him an IMSAI and told him to try it.

Wilcox came back with a two-board CPU set that contained the re-programmed 16-bit chip. He also wrote an operating system for it that could perform multi-tasking and multi-user operations. These became the Alpha Micro computer. John French and George Tate brought the Alpha Micro to the first computer show in Atlantic City in August of 1976. They were in the booth next to mine. My booth was where Steve Jobs and Steve Wozniak were showing the Apple I. They were attracting twice as much attention with their single-board computer as George and John French were with their advanced Alpha Micro computer. One reason for this was because the Alpha Micro was in an IMSAI chassis and looked like one of hundreds at the show. The other reason was the personality of Steve Jobs, who buttonholed everyone to come and see his "insanely great" machine.

After the computer show, John French concentrated

upon the development of Alpha Micro. George was left behind in the store with French's partner Alan. Tate always felt that he had contributed much to the development of Alpha Micro and had been shut out of the company. He stayed in the Computer Mart for a while and then left and went to work as western representative for Intercolor of Atlanta–the company that made the CompuColor Computers.

George's personal life was a bit uncertain in those days. Both he and his wife were adherents of Scientology, and through its teachings they decided that they were not suited for each other and divorced. Although he said he had done the correct thing, he was broken up about it and somewhat uncertain as to his future.

As far the computer business was concerned, George gradually came to believe that software, not hardware, was the key to marketing computers. He and a friend, Hal Lashley, opened a cut-rate software store and mail order business called Discount Software, which became quite a success. In spite of this, George Tate was looking for greener fields.

Wayne Ratliff had written a database system he called Vulcan. Wayne was a programmer, not a marketing person, and he had been selling his software without too much success at the time he brought it to George. George bought the rights to Vulcan from Wayne Ratliff because he believed it to be the best database management program ever developed for the personal computer. He knew he could market it more effectively. First he changed the name from Vulcan to dBASE, a name that was a contraction of "database." The full title was dBASE - Assembly Language, Relational Database System. However George wanted the software to appear as a perfected version, so he called it "dBASE II." (There never was a dBASE I.) George also did not want the "discount store" stigma attached to his new software, so he formed a new company that he called "Ashton-Tate" because he felt that "Tate" alone was too short. In addition, he liked the sound of the name. (There never was anyone named Ashton connected with the company.)

dBASE II first ran under the most popular operating system of that time, CP/M. Later, when the IBM PC was introduced, dBase II was upgraded to work on 8088 CPU's

under PC-DOS . It was also introduced for the ill-fated CP/M-86 operating system from Digital Research. dBASE II and later dBASE III became the most widely used database programs; they became the de-facto standards in the industry. George became rich, but he continued to work as hard as he did when he was "the Computer Doctor." He found someone new to share his life, but never remarried. Ashton-Tate became one of the major software companies in the industry.

Then in 1984, at the height of his career, George unexpectedly died. As often happens in the case of sudden death, his affairs were a mess. He had been in the process of getting rid of Discount Software, and there were various claims against his estate which had to be settled in the law courts. At Ashton-Tate, he was succeeded by David Cole, who only stayed at the helm for a short time and was replaced by Ed Esber, who ran the company until last year. In the face of declining business, The Board of Directors replaced Esber and appointed Bill Lyons in his place.

In spite of the death of George Tate, the company has profited by the great expansion of the industry. In recent years, however, its dominance of the database leadership has been challenged by other systems. In 1988, its dBASE III Plus held 70% of the market. In 1991, because of its failure to release a long promised compiler and the lower acceptance of dBase IV, its present market share is said to be about 38%. To many business people, Ashton-Tate had become a "one-trick-pony" trying to stop competition in the courts, rather than in the advanced software development labs.

Now Borland International, which started in business with a variety of languages, and has only recently gotten into data base systems, has overtaken and bought Ashton-Tate. Still under control of its dynamic founder, Philippe Kahn, Boland has a better chance of fighting off challenges by Oracle, Microsoft, and IBM, as well as the smaller data base competitors.

The rise and fall of Ashton-Tate sadly illustrates the historical cycle of companies founded by dynamic individuals who then depart for one reason or another. The company matures into complacency and eventually falls prey to takeover by more dynamic leadership.

Index

STAN VEIT'S HISTORY OF THE PERSONAL COMPUTER

In the beginning was Altair, which had to be assembled by hand and soldering iron.

Then came a parade of technologically improved personal computers vying for shelf space in Stan Veit's Computer Mart of New York.

Stan Veit's chronicles of the computer revolution, drawn from the pages of *Computer Shopper*, include computers that made it big, and computers that never made it out of the factory. He discusses PCs named IMSAI, SWTPC 6800, Z2, Sphere, OSI 400, TRS-80, PET, Amiga, TI99/4A, the Sorcerer, IBM PCjr, and many others.

He tells behind-the-scenes stories of the enterprising entrepreneurs, enthusiastic amateurs—and a few pirates—who made the personal computer revolution happen.

He describes the rise (and in the case of many, the fall) of computer companies—IMSAI Corporation, South West Technical Products, Apple Computer, Cromemco, Ohio Scientific, Processor Technology, the digital group, Radio Shack, Commodore, Atari, Texas Instruments, North Star, Osborne, Vector Graphic, Polymorphic, Heath, Morrow, Xitan, IBM, and more.

Here it is, Stan Veit's fascinating history of personal computers, gathered, expanded, and edited into one volume.

Published by:
WorldComm®
a division of Creativity, Inc.

$19.95 US / $24.95 Canada

9 781566 640237 51995

ISBN 1-56664-023-7

Stan Veit's History of the Personal Computer

WorldComm